UNITED STATES DISTRICT COURT
DISTRICT OF OREGON
PORTLAND DIVISION

NATIONAL STEEL CAR LIMITED, Plaintiff, v. THE GREENBRIER COMPANIES, INC. Defendant.	Case No. 3:20-CV-01275-YY DECLARATION OF BRIAN APEL IN SUPPORT OF THE GREENBRIER COMPANIES, INC.'S SUR-REPLY CLAIM CONSTRUCTION BRIEF

I, Brian Apel, declare as follows:

I am an attorney at Banner & Witcoff, Ltd., counsel of record for Defendant The Greenbrier Companies, Inc. ("Greenbrier") in the above-referenced litigation. I submit this Declaration in support of Greenbrier's Sur-Reply Claim Construction Brief. Unless otherwise indicated, I have personal knowledge of the matters stated in this declaration, and, if called to testify, I would testify as follows.

1. **Exhibit 19** attached hereto is a true and correct copy of the transcript of the deposition of Mr. Richard Dawson, P.E, conducted by NSC on December 3, 2020, including Mr. Dawson's Certification and Errata Sheet executed December 11, 2020.

2. **Exhibit 20** attached hereto is a true and correct copy of excerpts of the *Car & Locomotive Cyclopedia* (6th ed. 1997).

3. **Exhibit 21** attached hereto is a true and correct copy of the 2005 version of ASTM Standard A480/A480M-05, titled "Standard Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet, and Strip," obtained from https://www.astm.org/DATABASE.CART/HISTORICAL/A480A480M-05.htm.

Pursuant to 28 U.S.C. §1746, I declare under penalty of perjury that the foregoing is true and correct.

Executed this 14th day of January 2021.

/s/ Brian T. Apel
Brian Apel
Banner & Witcoff, Ltd.

UNITED STATES DISTRICT COURT
DISTRICT OF OREGON
PORTLAND DIVISION

NATIONAL STEEL CAR LIMITED,	)	
Plaintiff,	)	Case No. 3:20-CV-01275-YY
vs.	)	
THE GREENBRIER COMPANIES, INC.,	)	
Defendant.	)	

The Remote Zoom deposition of RICHARD DAWSON, called for examination, taken pursuant to the Federal Rules of Civil Procedure of the United States District Courts pertaining to the taking of depositions, taken before JANET L. ROBBINS, CSR No. 84-2207, Certified Shorthand Reporter of the State of Illinois, on December 3, 2020, at 9:04 a.m.

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REPORTED BY: JANET L. ROBBINS, CSR, RPR

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EXHIBITS

E X H I B I T S (Continued)

(Witness sworn.)
(Exhibit 0003 was marked for identification.)
MR. LEAVELL: Thank you.
Just for the record, Marc, we can agree that this deposition is being taken remotely due to COVID and that the parties agree that the court reporter swearing in the witness over video is acceptable to all parties, right?
MR. COOPERMAN: Agreed.
MR. LEAVELL: Thank you.

RICHARD DAWSON,
called as a witness herein, having been first duly sworn, was examined and testified as follows:

EXAMINATION

BY MR. LEAVELL:
Q. Good morning, Mr. Dawson. How are you?
A. Very good.
Q. You are currently living in the Naperville, Illinois area, is that correct?
A. No. I moved from Naperville to Cary, Illinois in June.
Q. Okay. So you currently live in Cary,

Illinois, and you're employed as a consultant?
A. Yes.
Q. Now, the materials provided by Greenbrier's counsel identified your testimony in the past four years.
And on that list there are two cases. One was a Tim Baird versus The Soo Line Railroad.
Do you remember that case?
A. Roughly, yes.
Q. And that was a personal injury case where Mr. Baird had been injured, correct?
A. Yes.
Q. And you rendered an opinion in that case, wrote a report and gave a deposition, is that correct?
A. Well, I did have a deposition. And, so, I mean, the report is whatever it is.
Q. Were you testifying on behalf of the plaintiff who was injured or the railroad?
A. On behalf of the railroad.
Q. And so you were deposed in that case, but it did not go to trial, correct?
A. Correct.
Q. The other case listed is a Barry Hoots

versus H&M International Transportation. And that was an Arkansas court.
Was that also a personal injury case?
A. Yes, it was.
Q. Did you work on behalf of the defendant in that case?
A. I did.
Q. Are you still working on that case or is your work finished?
A. No. So far as I know, the case is over and done with, and so I do not anticipate any further involvement in the case.
Q. And you were deposed in that case, the Barry Hoots case, right?
A. Yes, I was deposed.
Q. Do you know whether you wrote a report in that case?
A. I believe I did.
Q. You also worked on a case, Robert Wolf versus York Railway, back in the 2011 time frame, right?
A. I do remember working on a case involving York Railway. I no longer remember the names of the parties involved.

Q. This was the case where Mr. Wolf was claiming he injured his shoulder trying to undo the handbrake on the car.
Does that ring a bell?
A. That sounds familiar.
Q. Do you know whether you testified in that case?
A. To be honest, I don't recall.
Q. There was another case, Laurie Hickling versus the Delaware and Hudson doing business as CP Rail. And that was a case where the plaintiff fell off of a locomotive. It was moving slowly, and I think maybe the locomotive step hit her head, and she was suing for personal injury.
Does that ring a bell?
A. Yes, it does.
Q. And that was also in the 2011 time frame. I know you wrote a report.
Do you know whether you testified in that case?
A. Again, I don't recall testifying. It's possible that I did, but I don't recall at this point.
Q. Okay. So we've talked about four cases

so far.
Those were all personal injury cases, correct?
A. Yes.
Q. Have you ever served as an expert witness in a patent case before, before this case?
A. I guess that would depend on your definition of a patent case.
Q. Can you please explain?
A. Yes. I -- I testified in a case in which a company had acquired the patent rights from another company which went out of business. Several people who had worked for the company that had originally obtained the patents went into business for themselves making some of the same products. And they were sued by the company that purchased those patent rights claiming that they could not have developed and sold the products that they did without using the information from the patents.
And so I was asked to opine whether or not they could have developed the necessary information on their own without relying on the patents.

Q. We'll come back to that in a moment.
What was the name of the party or parties involved in that case?
A. The -- the company that was infused -- accused of infringement was Stanrail. The company that was suing them -- I'm trying to remember. I can see the guy's face in front of me who established the company.
The name is not coming to me right now.
Q. I'll come back and see if you remember that later.
This dispute, it was a legal case; it was a filed case somewhere?
A. Yes, I'm sure it was.
Q. Do you remember where it was filed? Was it in Chicagoland or somewhere else?
A. Well, they took my deposition in Chicago.
The companies involved, the plaintiff, while their operations were Michigan, I'm assuming it was a Michigan company; and the defendant, Stanrail Company or Corporation, was located in Indiana, but I don't recall where the case was filed.

Q. Is Stanrail two words, S-T-A-N, space, rail?
A. No, it was one word.
Q. When was your involvement in this case approximately?
A. I'd say 10 to 12 years ago, something like that.
Q. So if I understand correctly, there wasn't an allegation of patent infringement in this case against Stanrail; it was more a question of could Stanrail have developed this technology independent of the patent, is that correct?
MR. COOPERMAN: Objection --
THE WITNESS: Well --
MR. COOPERMAN: Mr. Dawson, you need to pause before you answer.
THE WITNESS: I agree.
MR. COOPERMAN: Object to the form of the question.
You can go ahead.
THE WITNESS: I guess it would depend on your definition of what constitutes patent infringement.
///

BY MR. LEAVELL:
Q. Were you asked in that case to determine whether any particular device infringed a patent or not?
A. I don't believe I was.
Q. Were you asked in that case to render any opinions about the proper construction of claim terms in the patent?
A. I'm sure I was not.
Q. Other than this Stanrail case, have you ever served as an expert witness in any case that was related to patents in any way?
A. I can't think of any.
Q. Prior to your involvement on this case, had you ever been asked to undertake any claim construction process for a patent?
MR. COOPERMAN: Objection to the form of the question. Also, objection, no foundation.
THE WITNESS: Well, my -- I was an inventor in a number of patents obtained by my employer. And I, at this point, don't recall the extent to which I and the other inventors were involved in the actual

construction of the claims or whether that was handled entirely by the patent attorneys.
Obviously, we provided information to them about the inventions, but I don't recall whether I was at all involved in the claim construction process.
BY MR. LEAVELL:
Q. Okay. When I say "claim construction," what does that mean to you?
A. It means --
MR. COOPERMAN: Objection, calls -- excuse me, Mr. Dawson.
Objection to the form of the question. Also, objection, calls for a legal conclusion.
You can answer.
THE WITNESS: To me, the term "claim construction" would mean the actual writing and -- of the word -- and the wording of the claims themselves in the patent.
BY MR. LEAVELL:
Q. Set aside any work that you did in preparing or assisting the preparation of patents naming you as an inventor, let's set that aside

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for now, have you ever, prior to this case, undertaken an interpretation of the claims or claim language of a patent invented by someone other than you?

MR. COOPERMAN: Object to the form of the question. Objection, no foundation.

Can you read the question back, please, Janet?

THE COURT REPORTER: Sure.

(The reporter read the record as requested.)

BY MR. LEAVELL:

Q. I'll rephrase the question.

Is that okay, Mr. Dawson, if I rephrase it?

A. Yes, thank you.

Q. Prior to your involvement in this case, have you ever undertaken an interpretation of any claim language of a patent that did not name you as an inventor?

MR. COOPERMAN: Objection to the form of the question. Objection, also calls for a legal conclusion and no foundation.

THE WITNESS: I guess I'm not clear

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what you mean by interpreting the claims in a patent.

BY MR. LEAVELL:

Q. When I say "interpreting a claim in a patent," what does that mean to you?

MR. COOPERMAN: Objection, calls for a legal conclusion.

THE WITNESS: Well, one way of understanding the term would be to read the claim and attempt to determine exactly what it covers and what it does not in the -- in the invention that's the subject of the patent.

BY MR. LEAVELL:

Q. Okay. Have you ever done that process before with respect to any patent other than one that names you as an inventor?

MR. COOPERMAN: Objection, no foundation.

THE WITNESS: Well, in the course of designing railcars and their components, I have on occasion looked at patents held by other parties to ensure that what I came up with did not infringe those patents. This

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obviously was not conducted in the legal arena at all. But in the course of doing that, I did try to understand what the patents covered and what they did not.

BY MR. LEAVELL:

Q. And that experience you've just described was in the context of your employment, not as an expert witness, correct?

A. That's correct.

Q. Prior to this case, have you ever been asked as an expert witness to render opinions about the meaning of claim terms in a patent?

MR. COOPERMAN: Objection to the form of the question. Objection, no foundation.

THE WITNESS: I can't think of any instance.

BY MR. LEAVELL:

Q. You've attached a CV to your report in this case.

Is that CV accurate and complete?

A. There's one inaccuracy in it. At the heading at the top of the first page, I list two telephones, a landline and a cell phone, and I no longer have the -- the landline telephone number.

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Q. Any other updates to your CV?

A. No.

(Exhibit 0001 was marked for identification.)

BY MR. LEAVELL:

Q. Have you reviewed your declaration since you signed it a few weeks ago?

A. Yes.

Q. How much time have you spent reviewing your declaration since the time you signed it on November 12th?

A. Perhaps one or two hours.

Q. And when did you spend one or two hours reviewing it? Was it the past few days?

A. Some of it was. I believe I probably reviewed it somewhat prior to that.

Q. Is there anything that you want to add or correct to your declaration before we get going today?

A. There is one error, which is that the captions for two of the figures are -- they're misplaced.

Q. Can you explain that, step me through it.

A. All right. So go to Page 10 of the declaration. And near the top of that page, there are two figures which are excerpts from two different drawings, and the captions for the two figures are reversed.
Q. So the upper figure on Page 10 is from drawing 4U-001-6, and the lower drawing is from drawing 4S-001-19, is that correct?
A. That's correct.
Q. Any other additions or corrections to your declaration beyond that?
A. I'm trying to think if there was.
No, I don't think so.
Q. In your declaration -- I've marked it as Exhibit No. 1 and introduced it.
You have a copy of that with you, correct, sir?
A. I do.
Q. In your declaration, you explain that you've got over 50 years of experience in the field of railcar design, right?
A. I'm not sure whether I said railcar design or railcar engineering. But, yes, I do have more than 50 years' experience.

Q. And paragraph 6 of your declaration, it says: I have over fifty years' experience in freight car railcar design -- sorry, freight railcar design, engineering, and construction.
A. Right. Yeah, there you are. So it hasn't been 53 years of design. But during those 53 years, they do include experience in all three of those activities.
Q. And in preparing your declaration and forming your opinions in this case, you drew upon that 50 years of experience in freight railcar design, engineering, and construction; is that fair to say?
A. Yes, it is.
Q. And in preparing the declaration and rendering the opinions in the declaration, you formulated your opinions and expressed opinions from the perspective of your 50 years of experience; is that accurate to say?
MR. COOPERMAN: Objection to the form of the question.
THE WITNESS: Yes, I would say so.
BY MR. LEAVELL:
Q. In forming your opinions and preparing

the declaration, did you identify other facts or data you considered but are not identified in your declaration?
MR. COOPERMAN: Objection to the form of the question.
THE WITNESS: Well, again, as indicated, I -- I based many of my opinions and statements in the declaration on, you know, an entire career's worth of experience, which included looking at documents, books, standards, specifications, drawings, stress analyses, and so forth, in addition to the -- those items that are listed in the declaration.
BY MR. LEAVELL:
Q. I understand. I understand that as a result of your 50 years' experience, there's a lot of things in your -- in your head that you drew upon.
But I'd like to focus on whether there were any other specific facts or documents that you considered beyond what's listed on Page 3 of your declaration or otherwise cited in the declaration. I'll explain and then I'll ask a

better question, okay?
I can read your list that's in your declaration, and I can read your declaration and find what you cited to. And I understand that on paragraph 10 of your declaration, you represent that these are the documents that you considered.
But what I'd like to know is were there other documents that you looked at as part of the process of preparing your declaration and forming your opinion but for whatever reason you chose not to consider them further, whatever that means in your words, or to list them in the declaration, okay?
MR. COOPERMAN: Objection --
BY MR. LEAVELL:
Q. Do you understand -- do you understand my explanation?
MR. COOPERMAN: Objection to the form of the question.
THE WITNESS: I think I understand what you're saying and --
BY MR. LEAVELL:
Q. So then let me -- let me ask the question then: Are there are any other facts or

any other documents that you looked at in preparing your declaration and forming your opinions but which are not identified in your declaration or listed on Page 3 or otherwise by citation?

MR. COOPERMAN: Objection to the form of the question. And objection, asked and answered.

THE WITNESS: Well, I guess that you're making a distinction between material that I've reviewed over the course of my career compared to material that -- specific material that I reviewed in the course of developing my opinions in the declaration.

And here, again, I think it's a case that in the process of working with the attorneys, I reviewed at one point or another a significant number of different documents, which -- not all of which ended up being in the list in paragraph 10. I can't specifically think of any.

Well, all right, here's one example. At one point we reviewed material from a book entitled, as I recall, The

American Freight Car written by John White. It's not listed in the documents in paragraph 10 and yet we reviewed some illustrations from it and other portions in it.

And so did they contribute to -- to my opinions and to what was written in the declaration? Perhaps. And I think there were a number of other documents, other patents, whatever, that would be in the same category.

BY MR. LEAVELL:

Q. Are you able to identify all such documents for me, or is that not possible?

A. No, it's not --

MR. COOPERMAN: Object --

THE WITNESS: -- possible.

BY MR. LEAVELL:

Q. There's no --

MR. COOPERMAN: Objection.

BY MR. LEAVELL:

Q. -- list that was written down or no list that was kept that identified such documents, is there?

MR. COOPERMAN: Objection to the form

of the question.

THE WITNESS: No, not that I'm aware of.

BY MR. LEAVELL:

Q. In forming the opinions in your declaration and drafting the declaration, were you careful to identify all assumptions that you were making?

MR. COOPERMAN: Objection to the form of the question.

THE WITNESS: I certainly never wrote them down.

BY MR. LEAVELL:

Q. Are there assumptions that you made when forming the opinion -- opinions in your declaration that you did not identify or set forth in the declaration?

MR. COOPERMAN: Objection to the form of the question.

THE WITNESS: I'm -- I'm not really sure I understand what you're getting at there.

BY MR. LEAVELL:

Q. Since you prepared your declaration,

has anything happened or have you reviewed anything that changes or alters any of the opinions in your declaration?

A. No.

Q. Since signing your declaration, have you reviewed any additional materials relating to the opinions set forth in your declaration?

A. I can't think of any.

Q. Did you meet with anyone to prepare for this deposition?

A. I had virtual conferences with the attorneys representing Greenbrier.

Q. And during those virtual conferences, did you review any materials other than those listed in your declaration or cited in your declaration?

A. It's entirely possible that we did.

Q. Do you recall what any of those documents are?

MR. COOPERMAN: I'm going to caution you, Mr. Dawson, that's a yes-or-no question.

THE WITNESS: So would you repeat the question, please?

///

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BY MR. LEAVELL:
Q. Do you recall the identity of any documents that you reviewed in preparation for your deposition that --
A. No.
Q. That's fine. If it's a no, then that answers my question.
How did the declaration come about? How was it prepared?
A. I had a number of discussions with the attorneys at Banner Witcoff about issues entailed in the litigation about the patents involved, about the --
MR. COOPERMAN: Mr. Dawson, I'm going to jump in and caution you. You should not be discussing the topics or the communications that you had with counsel. That's protected by work product.
And so you can talk about the number of discussions that you had, who you discussed with and when, but the actual topics you should not discuss.
THE WITNESS: And by the actual topic, Marc, I'm assuming you're also including the

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process by which the declaration was created?
MR. COOPERMAN: No, you can testify about the process.
THE WITNESS: All right.
MR. LEAVELL: And, Marc, I'm going to object to that instruction. I don't think he's protected by the privilege or the work product doctrine as an expert.
If you're going to assert privilege over the conversations that you've had with Mr. Dawson, then I won't go into those, but I'll deal with that with the Court. But I need to know now whether you're going to do that.
MR. COOPERMAN: I am. I don't see why communications with Mr. Dawson, who is an expert for Greenbrier, aren't protected as work product under Rule 26.
MR. LEAVELL: So I don't have to keep asking about his conversations with you to make a record of you objecting, we're going to assume you would object and instruct him not to answer?
MR. COOPERMAN: I don't think you

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should assume anything, Craig, because I don't know exactly what you're going to ask.
So ask what you feel like you need to.
BY MR. LEAVELL:
Q. So we're talking about the process of how your declaration came about. You said you had some conversations with the lawyers, and then somebody prepared a first draft of the declaration, correct?
A. That's right.
Q. Did you do that or did the lawyers do that?
A. The lawyers prepared the first draft.
Q. How many drafts were there?
A. To be honest, I don't recall a specific number.
Q. Approximately how many different drafts were there?
A. I would say on the order of two, three, four, something like that.
Q. When were you first retained for this matter?
A. In February of this year.
Q. February of 2020?

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A. Yes.
Q. How much time have you spent on this matter so far?
A. Perhaps 3, 400 hours, something like that.
Q. 3 or 400 hours?
A. Let me think. No, no. Wait a minute. Let me do my arithmetic here.
No, more like -- more like 30 to 40. It's like an error of a decimal place there.
Q. Do you have records that show how many hours you've worked on the matter?
A. I do.
Q. What do you call those records? Are they your invoices, bills, time sheets? How do you refer to those?
A. It's basically a time sheet that I use to -- to prepare my -- my invoices.
Q. Do you have access to that sheet now? Can you take a moment to check to see how many hours you've worked?
A. Yeah, I -- I don't have a running total in it, so I would have to add the hours up. But if you've got time for me to do that, I can do it.

Q. How long would it take?
A. Five, ten minutes, something like that, I would say.
Q. We'll come back to that, and I'll probably have you do that at some point.
In preparing your declaration or forming the opinions in your declaration, did you review the prosecution history of the patents at issue?
A. I recall that we considered a previous case in which National Steel Car sued FreightCar America for a patent infringement and that we looked at some of the documents that were prepared in connection with that lawsuit.
I don't recall looking at any -- any other cases involving these two patents.
Q. Do you understand the term "file history" or "prosecution history" of a patent? Do you know what that is?
A. Not really.
Q. When I said "prosecution history," you interpreted that to mean the history of prior assertions in the patent?
MR. COOPERMAN: Objection to the form

of the question.
BY MR. COOPERMAN:
Q. Like the case against FreightCar America, is that what you understood "prosecution history" to mean?
A. Yes, that was my understanding.
Q. Okay. In preparing your opinions and working on your declaration, did you review any of the communications back and forth with the patent office when a team from NSC was trying to obtain the patents at issue in this case?
MR. COOPERMAN: Objection to the form of the question.
THE WITNESS: Not that I can recall.
BY MR. LEAVELL:
Q. Did you review any of the prior art that's listed on the face of the asserted patents when forming your opinions and preparing your declaration in this case?
A. I did review some of the prior art during my work on this case. I'm not -- but I'm not certain whether or not that prior art was cited in the patents themselves. I would not be surprised if it was, but I'm not certain.

Q. Okay. So if I understand correctly, you've done some work evaluating prior art in connection with Greenbrier's invalidity case, but you did not, as part of the work in formulating the opinions and preparing your declaration on these issues in your declaration, you did not make an effort to look at the references that are cited on the face of the patents; is that a fair statement?
MR. COOPERMAN: Objection to the form of the question.
Janet, could you read that back, please?
THE COURT REPORTER: Sure.
MR. LEAVELL: I'll rephrase it. I'll break it down.
BY MR. LEAVELL:
Q. Mr. Dawson, you've worked with Greenbrier on its invalidity case, correct?
MR. COOPERMAN: I'm going to caution you, Mr. Dawson --
BY MR. LEAVELL:
Q. That's a yes-or-no answer.
MR. COOPERMAN: -- again not to get

into any specific communications you had with counsel.
BY MR. LEAVELL:
Q. It's just a yes or no as to what kind of work you've done so far.
A. Well, I guess I'm assuming here that the term "invalidity case" has a specific meaning, and I'm not sure I understand what that is.
Q. When you formed the opinions in your declaration to prepare the declaration, did you look at the face of the patents and notice that there were -- there's a list of patents and other publications on the face of the patent?
A. I -- I did observe that, yes.
Q. Did you -- as part of the work in forming the opinions in your declaration to prepare the declaration, did you review any of those patents or other publications for the purpose of forming the opinions in your declaration?
A. I'm not sure that I did.
Q. Do you know whether you've reviewed the Kiesel reference? I'll introduce that as an exhibit.

(Exhibit 0004 was marked for identification.)

MR. LEAVELL: So, for the record, Counsel, you should have access to Exhibit 4, which is U.S. Patent 1,962,717 to Kiesel. I'll share my screen now so that Mr. Dawson can see it.

It says the host has disabled screen share.

THE COURT REPORTER: Can we go off the record?

MR. LEAVELL: Sure.

(Whereupon, a discussion was had off the record.)

BY MR. LEAVELL:

Q. Mr. Dawson, are you able to see on my screen -- I'll zoom in for you, but you can see my screen, right?

A. Yes, I can, and I can see the drawing from the Kiesel patent.

Q. So that's Page 1. I'll page through the figures so you can get a feel for it.

The text is three pages, and the first several pages are diagrams.

Does this look familiar to you?

A. I've seen some of these diagrams before, perhaps a third of them, not all of them. And I'm not sure that I've seen any of the text.

Q. When did you see some of the figures of the Kiesel patent?

A. I'd say over the past four weeks or so.

Q. Did you look at it before you signed your declaration?

A. I know I've seen some of these after I signed the declaration. I may have seen some of them beforehand, but at this point I don't really recall.

Q. Okay. I'm going to zoom in on Figure VI.

Can you see that?

A. Yes.

Q. In Figure VI, I'll represent to you that -- and I can page through it if you need me to, but item No. 3 is referred to as a side truss, and item No. 11 is referred to as side plate.

MR. COOPERMAN: Mr. Leavell, can I interrupt? And I'm sorry to do this.

I would suggest if you're going to

ask some specific questions about the reference, that we take a break to try to get the Exhibit Share set up so it's easier for Mr. Dawson to flip through the document to the places he potentially would like to go to to answer a question. We think we've got it figured out offline.

MR. LEAVELL: I'm happy to take a quick break and set that up now if you think we can do it.

MR. COOPERMAN: Yeah. You're in the middle of a question, so I apologize if you want to finish your question, or we can take a break. It's up to you.

MR. LEAVELL: Let me see if we can --

BY MR. LEAVELL:

Q. Mr. Dawson, if you need the entire document to answer a question, speak up and we will take a break and we'll do that. We will take a break and we'll do that eventually. But I think I've got some basic questions that you can answer. But if you need to see the whole document, please speak up and I'll be happy to do that now. Okay?

A. All right.

Q. Item No. 46, do you see that on Figure VI? I'm circling it.

A. Oh, there it is. Yes, I do.

Q. That is identified as floor plate in Kiesel.

A. All right.

Q. And do you see item No. 6 here on Kiesel?

A. Yes.

Q. And do you understand that's showing a side sill?

A. That's --

MR. COOPERMAN: Objection to the form. Objection to the form of the question.

THE WITNESS: It's really hard to tell from just this view. It's clearly a rectangular flat bar oriented vertically. And depending on how it fits into the rest of the structure, I might consider it a side sill; I might not.

BY MR. LEAVELL:

Q. The side plate 11 is outboard of the floor plate, correct?

MR. COOPERMAN: Objection to the form

of the question.
THE WITNESS: Yeah, yes, item 11 --
MR. COOPERMAN: And I object, no foundation.
BY MR. LEAVELL:
Q. You can answer.
A. Yes, item 11 is outboard of the vertical flanges of the floor plate.
I'm -- yeah, I'm having trouble viewing the intersection of the floor plate, which is presumably -- oh, that's better.
Q. I zoomed in for you.
A. Yeah, yeah, that's better.
So item 46 and -- yeah, that -- yeah, okay. So that does cover the full width of the car as vertical --
MR. COOPERMAN: Janet, can you read back the question, please? I think it's been a while.
THE WITNESS: It has.
BY MR. LEAVELL:
Q. I'll re-ask it.
The side plate 11 is outboard of the

floor plate on this design, right?
MR. COOPERMAN: Objection to the form of the question.
THE WITNESS: But -- yes, item 11 is outboard of the vertical flanges formed in the floor plate, which is item 46.
BY MR. LEAVELL:
Q. Okay. So when you're referring to the vertical flanges of the floor plate, you're talking about where it turns and moves upwards in the drawing 90 degrees?
A. Yes.
Q. And the side plate 11 extends below the floor level in the Kiesel design in Figure VI, right?
MR. COOPERMAN: Objection to the form of the question. Also, objection, no foundation.
THE WITNESS: Yes, yes, item 11 does extend below -- below the floor plate.
BY MR. LEAVELL:
Q. And then item 11, the side plate, is connected to the item No. 6 under the floor --
MR. COOPERMAN: Objection.

BY MR. LEAVELL:
Q. -- under the floor, right?
MR. COOPERMAN: Objection to the form of the question. Objection, no foundation.
THE WITNESS: Yes, yes, item 6 is also below the floor plate and it is connected to item 11.
BY MR. LEAVELL:
Q. And item 6 is part of the underframe, correct?
MR. COOPERMAN: Objection to the form of the question. Objection, calls for a legal conclusion and no foundation.
THE WITNESS: I can't say that it is or is not. It depends on how the car is put together. And, again, it would be -- I don't think I could answer that question from just this drawing --
BY MR. LEAVELL:
Q. Okay.
A. -- or from this figure.
MR. LEAVELL: Let's go ahead and take a break and get the doc share going.
MR. COOPERMAN: Sounds good.

MR. LEAVELL: Thank you.
(Whereupon, a recess was had from 9:59 a.m. to 10:29 a.m.)
MR. LEAVELL: We're back on the record.
BY MR. LEAVELL:
Q. Mr. Dawson, during the break that we had where we set up the Exhibit Share for you, did you have any conversations with anyone about your testimony?
MR. COOPERMAN: Mr. Dawson, I'm going to caution you that any discussions that you had with counsel are privileged and work product. So for that particular question, I'm going to instruct you not to answer.
MR. LEAVELL: The question is a yes-or-no answer, did he have any conversations about your testimony with anyone during the break. He can answer that yes or no.
MR. COOPERMAN: I agree, you can answer that yes or no.
THE WITNESS: Yes, I did.
BY MR. LEAVELL:
Q. With whom did you discuss your

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testimony during the break?
A. With Mr. Cooperman.
Q. And for how long did you discuss your testimony with Mr. Cooperman during the break?
A. Perhaps 20 seconds, 30 seconds.
Q. And what did you two talk about?
MR. COOPERMAN: And that again, I'm going to instruct you not to answer on the grounds that it's work product and privileged.
BY MR. LEAVELL:
Q. Are you going to follow that instruction, sir?
Mr. Dawson, are you going to follow that instruction?
A. Am I -- oh, oh, oh, follow, okay. I thought you said file. Yes, I am going to follow that instruction. I wasn't sure how I was going to file the instruction.
Q. No, I apologize. I said follow because -- okay.
So as I understand it, Mr. Dawson, you're not going to tell me what you and Mr. Cooperman talked about during the break about

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your testimony, is that correct?
MR. COOPERMAN: Objection, asked and answered.
THE WITNESS: And --
MR. COOPERMAN: And object to the form of the question.
THE WITNESS: That's correct, I'm not going to.
BY MR. LEAVELL:
Q. Can you tell me the general subject matter that you discussed?
MR. COOPERMAN: You can talk about it in very general terms, Mr. Dawson, if you can.
THE WITNESS: He just commented about --
MR. COOPERMAN: Mr. Dawson, again, I'm going to instruct you not to discuss my comments specifically. And if you can't put it generally without giving away actual words that we discussed, then you should just say so.
THE WITNESS: Yes, I think it would be easier for me to simply say that I'm not

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going to answer that question.
BY MR. LEAVELL:
Q. Could you answer that question if counsel letted you -- let you? That's a yes or no.
A. I could, yes.
Q. All right. Mr. Dawson, do you have the document share program working? Are you able to look at Exhibits 1 through 4?
A. Yes, I am. Yes, I can.
MR. LEAVELL: I'm going to introduce Exhibits 5, 6 and 7.
(Exhibits 0005, 0006 and 0007 were marked for identification.)
MR. LEAVELL: And I'll introduce Exhibit 8 as well.
(Exhibit 0008 was marked for identification.)
BY MR. LEAVELL:
Q. Mr. Dawson, do you have access to Exhibits 5 through 8 now?
A. Well, let me see.
MR. COOPERMAN: You may have to refresh

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the program, Dick.
THE WITNESS: Yeah.
MR. COOPERMAN: There's a back button. Are you on the screen with the Exhibit Share?
THE WITNESS: No, no, I haven't gotten to that yet. I'm trying to remember how to get back to it because I'm not seeing a list of the programs down at the bottom of my screen.
MR. COOPERMAN: I think it's a Chrome browser window.
THE WITNESS: It is, but I'm not seeing the access to the Chrome browser at this point.
Video -- no, I'm still not seeing -- down at the bottom I'm not seeing all of the other stuff in the tray.
MR. COOPERMAN: Okay. Mr. Leavell, you want to go ahead and just put it on the screen?
THE WITNESS: All right. There it is. Okay.
BY MR. LEAVELL:
Q. I'm sharing my screen now. First I'm

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going to show you Exhibit 8.
A. Yeah, okay.
Q. Exhibit 8 is a printout from the Greenbrier website. If you go to their website and you click on Manufacturing, North America Gondolas, there's four cars identified?
A. Right.
Q. And then the next page is -- I'm sorry.
So that's the first page or any page when you click on North America Gondolas. You see there's four designs, right?
A. Yeah.
Q. And the 7100 Woodchip Gondola, that's one of the accused cars in this case.
Do you understand that?
A. I do.
Q. And the other three railcars are not accused in this case, at least not yet.
Do you understand that?
A. I do.
Q. Okay. I'm going to bring up now Exhibit 5, which is the 52 mill gondola car, which if you click on the image of that on Exhibit 8, this is, again, on the Greenbrier

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website.
A. Okay.
Q. Are you familiar at all with the Greenbrier 52' mill gondola?
A. I'm familiar in a general sense with the 52' mill gondolas. I'm not specifically familiar with Greenbrier's car.
Q. Okay. Looking at the diagram of the car on Exhibit 5 and the photograph of the car on Exhibit 5, are you able to confirm for me that this design has a side sill?
MR. COOPERMAN: I'm going to object to the form of the question.
I also -- I want to pose a question to you, Mr. Leavell, as to how this relates to Mr. Dawson's expert declaration or the opinions in it.
As you know, general discovery is --
MR. LEAVELL: I'm not -- I'm not going to where you think I'm going, Marc. Give me a couple of minutes.
MR. COOPERMAN: Well, I'm going to go ahead and -- I'll give you a little bit of

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leeway, but this really -- again, the Court entered an order, as we know --
MR. LEAVELL: I know.
MR. COOPERMAN: -- sustaining discovery except for claim interpretation, so --
MR. LEAVELL: Understood.
BY MR. LEAVELL:
Q. Mr. Dawson, do you recognize this 52' mill gondola car to be a traditional gondola design?
A. It certainly appears to be.
Q. And when I say "a traditional gondola design," do you understand that to mean that it's got a side sheet that's outboard of the floor, that extends below floor level and connects to a side sill under the floor?
MR. COOPERMAN: Object to the form of the question.
THE WITNESS: Well, that certainly appears to be the case in the photograph.
The drawing, I'm having some difficulty interpreting that because I see two horizontal lines, which are at what appears to be floor level, and I don't

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understand what they represent. Because the side sheet appear to extend further down below the floor to the bottom edge of the side assemblies. But, as I say, I -- I don't understand what those two horizontal lines are in the diagram.
BY MR. LEAVELL:
Q. In the photograph on Exhibit 5, you can tell there's a side sheet that extends below floor level and connects to a side sill under floor level. You can see that in the photograph, right?
A. Well --
MR. COOPERMAN: Object to the form. Object to the form of the question. Also, objection, calls for a legal conclusion.
THE WITNESS: It's not sufficiently clear to me that the side sheet does, in fact, extend all the way down to the bottom of the side. I notice that the side posts do not. And -- yeah, there's just not sufficient detail in this photograph for me to be able to tell.
BY MR. LEAVELL:
Q. Okay. I should be sharing my screen

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with you. This is a 66' gondola. This is Exhibit No. 6.

Are you able to identify this as a traditional gondola design?

A. It appears --

MR. COOPERMAN: Objection to the -- objection to the form of the question.

And, Mr. Dawson, you need to pause to allow me to object if I need to.

THE WITNESS: I agree.

BY MR. LEAVELL:

Q. You agree? Okay.

Can you tell from the photograph of this car that the car -- and I'll zoom in on the photograph -- that the car has a side sheet that's outboard of the floor, that extends below floor level and then is connected to a side sill below floor level?

MR. COOPERMAN: Objection to the form of the question. Objection, no foundation and calls for a legal conclusion.

THE WITNESS: I'm not sure that the side sheet does extend below the floor all the way to the bottom of the side. Similar

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to the photo of the 52' gon, it looks as if there is a horizontal edge that's approximately at floor level and may indicate that the side sheet ends at that point.

And so it's conceivable that the -- and this is speculation now on my part because I can't really see it well enough to tell. And what I'm seeing would be consistent with a side sheet that ends right about at or very slightly below floor level and is then attached to hot rolled channel side sill, which extends the rest of the way down, but I just can't be certain from seeing this and there's not enough information in the drawing to -- to help me to determine that.

BY MR. LEAVELL:

Q. I have on my screen now Exhibit 7. This is the 1800 Gondola from the Greenbrier website.

Do you see that exhibit, sir?

A. I do.

Q. I'll zoom in. I'll try to zoom in here.

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All right. I've zoomed in to the photograph.

Do you see that?

A. I do.

Q. And I'll scroll down to the diagrams.

Do you see those?

A. Yes.

Q. All right. Are you able to confirm that this is a traditional gondola design?

MR. COOPERMAN: Objection to the form of the question. Objection, no foundation.

THE WITNESS: It appears to be. We've got a little bit more detail on this one than on the -- the other two. But I --

MR. COOPERMAN: And for the record, just to make it clear, we're all looking at Mr. Leavell's screen, and he's, I think, doing his best to show the image to Mr. Dawson.

MR. LEAVELL: Yes.

MR. COOPERMAN: And Mr. Dawson isn't at this point in time able to control it because of his being remote and the technology issues we're having.

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BY MR. LEAVELL:

Q. Well, Mr. Dawson, if you need me to zoom in or scroll anywhere on the document, the one-page document, I'm happy to do so. Just ask. Okay?

A. Yeah. If you can zoom in a little on the two views on the left here, the -- the upper plan view and the lower elevation view, yeah, they help somewhat.

MR. COOPERMAN: And then, Janet, can you read back the question that's pending so we have it in mind?

THE COURT REPORTER: Sure.

(The reporter read the record as requested as follows:

"Q Are you able to confirm that this is a traditional gondola design?")

THE WITNESS: I guess that would lead me to ask what you mean by a "traditional gondola design."

BY MR. LEAVELL:

Q. As that term is used in your declaration.

A. Well, it is certainly a fairly conventional gondola design. It appears to use a hot rolled channel side sill --

THE COURT REPORTER: Did you say hot roll? I'm sorry. Did you say hot roll, R-O-L-L?

THE WITNESS: Hot rolled, R-O-L-L-E-D. (Continuing) -- hot rolled channel side sill with the side sheet extending down to just below the top of the side sill channel and the floor presumably resting on top of the top flange of the side sill channel.

BY MR. LEAVELL:

Q. And the side wall -- side sheet, I should say, the side sheet is outboard of the floor in this design, right?

A. Yes.

MR. COOPERMAN: Objection to the form of the question.

BY MR. LEAVELL:

Q. The side sheet --

MR. COOPERMAN: Objection, calls for a legal conclusion.

THE WITNESS: The side sheet --

MR. COOPERMAN: Mr. Dawson, you need to pause.

BY MR. LEAVELL:

Q. And the side sheet extends below floor level and is connected to the side sill below floor level, correct?

MR. COOPERMAN: Objection to the form of the question.

THE WITNESS: That appears to be the case from what we can see here.

BY MR. LEAVELL:

Q. In forming your opinions and preparing your declaration, did you evaluate any of the nonaccused Greenbrier railcars in this case?

A. Not these three, no.

Q. "These three" being Exhibits 5, 6, and 7?

A. Correct.

Q. You can turn to your declaration. You've got that in hard copy, right?

A. I do.

Q. In paragraph 14 of your declaration, on Page 4, you discuss the level of experience of a

person having ordinary skill in the art, right?

A. Yes.

Q. Is this your opinion, did you come up with this definition, or were you instructed by counsel to assume this definition of a person of skill in the art?

A. Neither.

Q. How did you get this definition of a person of skill in the art?

A. The -- the initial definition was drafted by the attorneys, and that was in the first draft of the declaration. And we had some discussions, which ended up modifying it. And I eventually agreed with what is shown now as paragraph 14.

Q. Were you aware when you were forming your opinions and drafting your declaration that National Steel Car had set forth the definition for a person of ordinary skill in the art in their brief?

MR. COOPERMAN: Objection to the form of the question.

THE WITNESS: To be honest, I'm not sure whether I was or not.

BY MR. LEAVELL:

Q. You reviewed NSC's opening claim construction brief while preparing your declaration, right?

A. I did, but I did not read the entire document.

Q. Did you consider National Steel Car's description of a person of ordinary skill in the art and then make a decision that you disagreed with it and needed to set forth your own definition or did that not happen?

MR. COOPERMAN: Objection to the form of the question.

THE WITNESS: That did not happen.

BY MR. LEAVELL:

Q. So when you were describing the level of experience of a person having ordinary skill in the art, were you opining -- were you meaning to opine that National Steel Car's definition was incorrect and that yours was more correct?

A. I did not consider National Steel Car's definition at all. And so I couldn't tell you today the extent to which their definition differs from what is here. This is my opinion, which may

or may not coincide with National Steel Car's.
Q. On Page 3, I'll read from National Steel Car's brief.
Do you have that before -- do you have that in front of you?
A. Let me get it.
MR. COOPERMAN: Dick, it should be Tab 3 in the materials we sent you.
THE WITNESS: All right. Okay. So where did you say it was in National Steel Car's? So this is National Steel Car's opening claim construction brief; is that the right document?
BY MR. LEAVELL:
Q. Yes, sir, Page 3.
A. There we are.
Q. And do you see on the bottom of Page 3 where the brief discusses the level of ordinary skill in the art?
A. I do.
Q. And it's described as having a bachelor's degree in mechanical engineering, structural engineering or a related field of study and two to three years of industry experience

relating to the design of railcars.
A. I see that.
Q. Do you have any dispute with that definition of a person of ordinary skill in the art, or do you agree that that would be appropriate to use in this case?
MR. COOPERMAN: Objection to the form of the question.
THE WITNESS: No, I -- I do not agree with that definition. It implies that no person without a bachelor's degree in mechanical engineering, structural engineering or a related field of study could be a person of ordinary skill in the art. My opinion is that a person without a bachelor's degree in engineering but with a greater amount of time and -- and experience in the related field could be equally skilled in the art.
BY MR. LEAVELL:
Q. So as between National Steel Car's definition of a person of ordinary skill in the art and your definition, you agree that there is a material difference between those definitions?

MR. COOPERMAN: Objection to the form of the question.
THE WITNESS: In my opinion, there is a -- there is a difference in terms of whether or not having a bachelor's degree is a necessary condition of being a person having ordinary skill in the art.
BY MR. LEAVELL:
Q. When you formed your opinions and prepared your declaration, you were using your definition of a person of ordinary skill in the art, not NSC's, right?
MR. COOPERMAN: Objection to the form of the question.
THE WITNESS: Yes, I based it on my definition, my understanding of what would constitute a person having ordinary skill in the art.
BY MR. LEAVELL:
Q. If you could turn back to your declaration.
A. All right.
Q. I want to look at Exhibit 2 to your declaration.

MR. COOPERMAN: Craig, did you mark the Green- -- I'm sorry, the NSC brief as an exhibit?
MR. LEAVELL: I did not.
MR. COOPERMAN: Okay.
MR. LEAVELL: I can.
MR. COOPERMAN: It's up to you. I just wanted to make sure I didn't miss it.
THE WITNESS: All right. I'm looking at Exhibit 2.
BY MR. LEAVELL:
Q. And if you can look at Page 2 of Exhibit 2 to your declaration, which is it's Page 39 of 44, if you've got the version that was filed with the Court.
A. Yes, I see that. Yeah.
Q. And I'll bring that up. Let me bring that up on my screen so I can direct you.
So I've got it on my screen, but you've got this in hard copy. This is the representation of the Greenbrier accused car that you attached to your declaration?
A. Yes.
Q. And for the record, it's -- I'll make

this -- I think I've already introduced it.
MR. COOPERMAN: I think you have, too.
BY MR. LEAVELL:
Q. Yeah, this is part -- part of your declaration. And it's Page 38 of 44 on the filed copy of your declaration. And it's 38, 39, and then 40, right? Well, 38 and 39 of the representation of the Greenbrier accused car and then there's a comparison on Page 44.
A. Yes.
Q. All right. So on Page 39 of 44, you've got a representation of the Greenbrier accused car. I'm sharing that one on my screen.
And you've got that in front of you, right?
A. I do.
Q. Now, the -- and this diagram shows the green item, which is labeled as side post gusset, located significantly higher than what's been labeled as the floor panel, right?
MR. COOPERMAN: Objection to --
THE WITNESS: Actually, that's not true.
MR. COOPERMAN: Objection to the form

of the question.
Again, Mr. Dawson, you need to pause.
THE WITNESS: Yeah.
BY MR. LEAVELL:
Q. Well, in this diagram, the side post gusset, which is green, is located higher than floor level, right?
MR. COOPERMAN: Objection to the form of the question.
THE WITNESS: Actually, it's not. It's -- it's a consequence of the way that the drawing was made, which is isometric. And the side post gusset is longitudinally some distance behind where the side sill and the floor panel and the web are cut. And it actually is at approximately the same level as the horizontal flange of the side sill.
When I first looked at this diagram, I had the same impression that you do. But upon closer reflection, I came to realize that, in fact, the way that it is shown is an incorrect impression.
///

BY MR. LEAVELL:
Q. So we can agree that this page, Page 39 of 44, gives an incorrect impression of the design of the accused railcar?
A. In terms of --
MR. COOPERMAN: Objection to the form of the question.
You can answer.
THE WITNESS: It -- it provides -- no, this page, this diagram provides a misleading impression. But if one looks at it carefully and considers how isometric views are made, one will realize that it is, in fact, correct.
BY MR. LEAVELL:
Q. Well, when you first looked at this, you were misled to understand that the side post gusset was elevated higher than the horizontal -- horizontal leg of the red piece and the floor panel, right?
MR. COOPERMAN: Objection, asked and answered.
THE WITNESS: Yeah, I have nothing further to add to my previous answer.

BY MR. LEAVELL:
Q. And then while you were forming your opinions and preparing your declaration, for at least some part of the time you still had that understanding, right?
MR. COOPERMAN: Objection to the form of the question.
THE WITNESS: I can't really say when I realized that the drawing was, in fact, correct. It certainly was before I completed and signed the declaration. But how long before that, at this point I can't say.
BY MR. LEAVELL:
Q. Was it after you started preparing the declaration but before you signed it; is that your testimony?
A. Yes, it is. Yes, it was.
Q. Do you have any way of pinpointing when in the process of preparing your declaration you realized that your understanding of the green piece here on this representation of Greenbrier's accused car was incorrectly -- that you were misunderstanding this drawing?
MR. COOPERMAN: Objection. Objection

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to the form of the question. Objection, asked --
MR. LEAVELL: I'll re-ask it. I'll re-ask it.
BY MR. LEAVELL:
Q. Do you have any way of pinpointing when during the process of forming your opinions and preparing your declaration in this case you realized that your initial impression of this diagram on Page 39 of 44 of your declaration had misled you?
MR. COOPERMAN: Objection to the form of the question. Objection, asked and answered.
THE WITNESS: No, I don't have an understanding of when that occurred.
BY MR. LEAVELL:
Q. Do you have any records or any way to figure that out?
A. No.
Q. Who created this diagram that we're looking at on Page 39 of 44 of your declaration?
A. It was created by artists hired by the attorneys.

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Q. Were you involved in guiding those artists on how to create this diagram?
MR. COOPERMAN: Objection to the form of the question.
THE WITNESS: No, I was not.
BY MR. LEAVELL:
Q. Were you involved in any way in the creation of this diagram?
MR. COOPERMAN: Objection to the form of the question.
THE WITNESS: No.
BY MR. LEAVELL:
Q. Have you ever inspected a physical sample of an accused Greenbrier car?
A. Assuming that the accused cars, I believe there are two different cars produced by Greenbrier that are accused in the lawsuit, and I have not physically inspected examples of either car.
Q. On paragraph 30 of your declaration, which spans Pages 15 and 16 --
A. Go ahead.
Q. -- you discuss the design shown in Figure 9 of your declaration, right?

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A. Yeah, right. So I -- I discuss gondolas with straight-through center sills. And Figure 9 is shown as an illustration of that type of construction.
Q. Now, you referred to the design shown in your Figure 9 as a prior art gondola, right?
A. Yes, I believe I do.
Q. So when you prepared your report and formed your opinions, did you assume that this drawing showed a car that had actually been built?
MR. COOPERMAN: Objection to the form of the question.
THE WITNESS: I don't recall making an assumption one way or the other.
BY MR. LEAVELL:
Q. Why did you refer to it as a prior art gondola? Who told you it was prior art?
A. I believe I was informed of that by the attorneys.
Q. So you don't have any actual recollection -- or knowledge, personal knowledge, as to whether this is or is not a prior art gondola, do you?
MR. COOPERMAN: Objection to the form

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of the question.
THE WITNESS: I have no personal knowledge, no.
Let me put it this way: I certainly know that both straight-through and stub center sills have been used for many, many years as part of the prior art.
I -- other than what was represented to me, I have no personal knowledge of whether this particular car was pre -- or pre-dates the -- the two patents at issue.
BY MR. LEAVELL:
Q. When you say "this particular car," it's a -- it's a drawing, right; it's not an actual car?
A. Well, the car represented by the drawing. It is a drawing of a car, and that is the car that I am referring to.
Q. Okay. When you formed your opinions and wrote your declaration, your understanding was that there was an actual car that had been built according to this diagram; that's what you assumed, right?

MR. COOPERMAN: Objection to the form of the question.
THE WITNESS: I'm not sure that I did. I -- I considered this a represent -- representation of a car that may or may not have actually been built. But whether or not it was, it still serves as a good illustration of a car with a straight-through center sill.
BY MR. LEAVELL:
Q. So you don't know, in fact -- I think you've already answered this, and I apologize if you did have, but you don't know whether the design that's shown in Figure 9 of your report is, in fact, a prior art gondola, do you?
THE COURT REPORTER: You said prior art what?
MR. LEAVELL: Gondola. Gondola.
MR. COOPERMAN: Objection, asked and answered.
THE WITNESS: I have nothing further to add to my previous answers.
BY MR. LEAVELL:
Q. And your previous answer was that you

relied on what the lawyers told you; you don't know whether this is an actual prior art gondola or not, right?
MR. COOPERMAN: Objection, misstates testimony. Objection, asked and answered.
THE WITNESS: Yeah, I have nothing further to add.
BY MR. LEAVELL:
Q. Are you familiar with conventional -- railcars that have conventional side sheets that are surface covers but do not contribute to supporting the bending load?
MR. COOPERMAN: Objection to the form of the question.
THE WITNESS: If by a side sheet you're referring to a sheet of steel, then in my opinion there is no such thing as a gondola having steel side sheets which do not contribute to the ability of the car structure to resist bending loads.
BY MR. LEAVELL:
Q. In your answer, you made two assumptions: One, that there's steel; and, two, that it's a gondola car, right?

A. Well, I believe I said if the side sheet is -- is a steel sheet. But in terms of it's -- whether or not it's a gondola car or another car type, say a box car or an open-top hopper car, the principle would be the same. It doesn't matter whether it's a gondola or not.
Q. Okay. So what you're telling me is that as long as it's a steel sheet, then it necessarily contributes to supporting the bending load, whether it's a gondola car or a box car or some other kind of car; is that your testimony?
MR. COOPERMAN: Objection to the form of the question.
THE WITNESS: Yes, it is.
BY MR. LEAVELL:
Q. Are you aware of conventional side sheets that are often surface covers but do not contribute to supporting the bending load?
MR. COOPERMAN: Objection to the form of the question. Objection, calls for a legal conclusion.
THE WITNESS: I believe I already answered that in which I said if the -- it doesn't matter whether it is -- the side

sheet is there as a surface cover, which is a term that I'll have to say I'm not familiar with, or is intended by the designer to contribute to the beam strength of the car. If it is there, it does contribute to the bending strength of the car.
BY MR. LEAVELL:
Q. What about cars with wooden slats? Would they -- would they have a -- am I correct that a car with wooden planks or slats as a side wall, would you at least agree that that is not a beam?
MR. COOPERMAN: Objection to the form of the question.
And, Counsel, again I'm going to ask you how this relates to Mr. Dawson's opinions or declaration. It seems to be going off plan.
MR. LEAVELL: I'm confident it does. I don't think I need to reveal my thinking here, but it does.
MR. COOPERMAN: Well --
MR. LEAVELL: You'll see -- you'll see in a few minutes.

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MR. COOPERMAN: If you could at least give me a general explanation and then I'll feel more comfortable letting Mr. Dawson go ahead. But this, on its surface, seems like you're trying to get potentially invalidity-type testimony from Mr. Dawson, which, of course, the discovery on invalidity is not open and Mr. Dawson isn't opining on invalidity in this expert report.

BY MR. LEAVELL:

Q. Mr. Dawson, there are gondola cars out there that have non-beam sides, right?

MR. COOPERMAN: Objection to the form of the question.

THE WITNESS: No, there are not.

BY MR. LEAVELL:

Q. Okay. So every gondola that has a side, in your opinion, has a beam as a side; that's your testimony?

MR. COOPERMAN: Objection to the form of the question. And objection, calls for a legal conclusion.

THE WITNESS: The side assembly of any gondola functions as a beam.

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BY MR. LEAVELL:

Q. Even if it has wooden slats for the side sheet?

A. That's correct.

MR. COOPERMAN: Objection to the form of the question. Again, objection, calls for a legal conclusion.

THE WITNESS: Other parts of the side enable the side assembly to function as a beam. In that instance, the wooden side members do not contribute to the strength of the side, but the side still functions as a beam.

BY MR. LEAVELL:

Q. What about truss-side gondola cars? Would you agree that those are different than a gondola car with a side beam?

MR. COOPERMAN: Objection to the form of the question.

And, again, Counsel, can you explain how this relates to Mr. Dawson's opinions or declaration?

MR. LEAVELL: Yes. In paragraph 31, he says there's no such thing as a non-beam side. I'm exploring that with him.

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MR. COOPERMAN: Okay. Could you restate the question or --

MR. LEAVELL: Can you withdraw the objection?

MR. COOPERMAN: I'm not going to until I hear the question back.

So, Janet can you please --

MR. LEAVELL: I'll rephrase it. I'll rephrase it. You can object if you need to, but that's irrelevant.

BY MR. LEAVELL:

Q. Mr. Dawson, are you ready?

A. I'm ready.

Q. Do you agree or disagree that a railcar -- a gondola railcar can have a truss side rather than a side beam?

MR. COOPERMAN: Objection to the form of the question.

THE WITNESS: A truss side is a side beam.

BY MR. LEAVELL:

Q. A truss side -- a truss is made up of beams, right?

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MR. COOPERMAN: Objection to the form of the question. Objection, calls for a legal conclusion.

THE WITNESS: A truss is made of a number of structural elements, which when combined constitute a beam. The diagonals in a truss, for example, do not function as beams since they only take axial -- they only support axial loads.

BY MR. LEAVELL:

Q. So as you use the term "beam," it's synonymous with truss when it comes to gondola cars?

MR. COOPERMAN: Objection to the form of the question. Objection, calls for a legal conclusion.

THE WITNESS: No, that is -- that is not how I would -- would view -- I would not view a truss-side gondola as being synonymous with a beam.

BY MR. LEAVELL:

Q. Is a beam a type of beam? A gondola with a side beam, is that a subset of a truss? Or is a truss a species of a beam? How are they

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related if they're not --
MR. COOPERMAN: Objection to the --
BY MR. LEAVELL:
Q. -- synonymous?
MR. COOPERMAN: Objection to the form of the question. And objection, calls for a legal conclusion.
THE WITNESS: A truss side is one form of beam structure.
BY MR. LEAVELL:
Q. I'm going to introduce the next exhibit, which I think is Exhibit 9, yes.
(Exhibit 0009 was marked for identification.)
BY MR. LEAVELL:
Q. And I'll share my screen with you, Mr. Dawson.
Are you still unable to pull up the exhibits?
A. Yeah, I don't seem to be able to get out of the --
Q. That's fine. I don't need an explanation. I just want to know whether you can see it. So we'll do the screen share.

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A. Maybe we can figure out how to do this in the next break, but as of the moment I can't access it.
Q. I'm sharing my screen. I've introduced Exhibit 9.
I'll scroll through it so you can see how many pages there are. One, two, three, four, five pages.
I'm happy to turn back to anything or show you anything you want to see. But what I'd like to discuss is, first, the car shown on the bottom of the first page of the exhibit, which I'm showing you here on Page 158 --
A. Right.
Q. -- the G-70-15 car, which is described as a truss-side design. The sheathing is plywood.
And I'm assuming that the truss structure is steel.
Do you agree that's a fair assumption?
MR. COOPERMAN: Objection to the form of the question. And objection, no foundation.
THE WITNESS: I would assume that as well.

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BY MR. LEAVELL:
Q. Well, let's assume that it's steel, the truss structure is steel, and the -- as it says, the sheathing is plywood.
And by "sheathing," we're talking about the side sheet where -- behind the truss running vertical, right?
MR. COOPERMAN: Objection to the form of the question. Objection, calls for a legal conclusion.
THE WITNESS: Yes, I -- that is what I would consider the sheathing of the sides.
BY MR. LEAVELL:
Q. Okay. And I'll scroll down. Here's the interior of the car.
This particular gondola had bottom doors. And that's where it's shown emptying out on Page 159?
A. Yeah. Actually, that's a different car emptying out on Page 159, but I think -- because you'll notice that that car has steel side sheets and does not have diagonal --
Q. You're right.
A. -- truss members. But I'm sure that

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the floor configuration is -- is the same.
Q. Okay. And we've got on Page 160, there's the G-100-11, which is a 100-ton wood chip car.
Do you see that?
A. Yes.
Q. And this was designed for rotary dumping rather than bottom dumping through drop doors.
Do you see that?
MR. COOPERMAN: Objection, no foundation.
BY MR. LEAVELL:
Q. Go to the next page and there's a diagram of the G-70 --
A. Yes, it's --
Q. -- being rotary dumped?
A. -- being rotary dumped, yeah.
THE COURT REPORTER: I'm sorry. Both of you are talking over each other.
Can you repeat that, Craig?
MR. LEAVELL: I'll try.
BY MR. LEAVELL:
Q. So on Page 161 of Exhibit 9, there's a

diagram of a car being rotary dumped, right?
A. Yes.
Q. Now, on Page 160, do you agree that this is a diagram -- well, if we assume this also has wooden sheathing, which appears to me it does, do you agree that that's what appears what is shown?
A. Well, it would look --
MR. COOPERMAN: Objection to the form of the question.
Mr. Dawson, you need to pause, please.
THE WITNESS: It would look that way, and yet in the caption for the photograph it says it was all steel construction, which implies that the side sheathing was, in fact, steel sheets.
Frankly, it doesn't make sense to me why they would retain the diagonal members on a car with steel sheathing, but that's -- that's what it says.
BY MR. LEAVELL:
Q. Let's talk about the design with -- with the truss side and the wooden sheathing.

Okay?
A. All right.
Q. It's your testimony that this would -- such a design would be a car that, as you use the term, has a side beam?
A. Yes, it does.
Q. So as you use the term "side beam" in your opinion in your declaration, you're meaning a beam would include a railcar with wooden sheathing and a truss design, right?
MR. COOPERMAN: Objection to the form of the question.
THE WITNESS: Yes, I -- yes, the -- a gondola car with side beams would include cars with truss sides even if the sheathing was wood.
BY MR. LEAVELL:
Q. A design like shown on Exhibit 9, Page 158 with a truss side and wooden sheathing, would it have a side wall web?
MR. COOPERMAN: Objection to the form of the question. Objection, calls for a legal conclusion.
THE WITNESS: Now we're getting into

the definition of the term "web."
I would be inclined to say no, that since the wood sheathing does not contribute to the bending strength of the side, that I would not consider that wood sheathing to be a web.
BY MR. LEAVELL:
Q. When you say it contributes to the load on the side --
A. That's not what I said.
Q. What did you say? I'm sorry. Say it again.
A. It contributes to the -- I don't remember the exact words, but that it contributes to the bending strength of the sides.
Perhaps we ought to ask the court reporter -- recorder to repeat what I did say.
Q. Well, I'm happy to have her repeat it, if you'd like her to. Would you like her to?
A. Yes, if we're going to talk about what I said, let's hear.
Q. You can change what you said. We can work with whatever you -- whatever you think is right.

A. Well, you were making the statement about what I said.
MR. LEAVELL: Let's hear what he said. Can you read it back, Janet? Do you know what we're looking for?
THE COURT REPORTER: Yes.
(The reporter read the record as requested as follows:
"A Now we're getting into the definition of the term 'web.'
I would be inclined to say no, that since the wood sheathing does not contribute to the bending strength of the side, that I would not consider that wood sheathing to be a web.")
MR. LEAVELL: All right. Thank you.
BY MR. LEAVELL:
Q. Are we okay with that language?
A. Yes.
Q. So because the wood sheathing would not contribute to the bending strength of the side, you would not consider that to be a web, right?
MR. COOPERMAN: Objection to the form

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of the question.
THE WITNESS: Yes.
MR. COOPERMAN: And objection, calls for a legal conclusion.
THE WITNESS: Yeah, I would not consider it to be a web, as I understand the term "web."
BY MR. LEAVELL:
Q. And is your understanding of a web consistent with how a person of ordinary skill in the art would have considered, understood the term "web" back in 2005 or is it different?
A. No, I believe that a person of ordinary skill in the art would interpret the term "web" the same way that I do.
Q. Now, when you say that it has to contribute to the bending strength of the side, the web accomplishes that by carrying shear, right?
MR. COOPERMAN: Objection to the form of the question. Objection, calls for a legal conclusion.
THE WITNESS: Yes, the web does carry shear loads.

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BY MR. LEAVELL:
Q. When you say that the web has to contribute to the bending strength of the side, what you're thinking of is the contribution by the web to the bending strength of the side is because it carries that shear, correct?
A. Well --
MR. COOPERMAN: Objection to the form -- objection to the form of the question. Objection, calls for a legal conclusion.
You can answer.
THE WITNESS: Well, the web not only carries shear load; it also contributes, to an extent, to the longitudinal bending stresses at the top, you know, of the beam as well as the shear load -- shear stresses.
BY MR. LEAVELL:
Q. But when a recent -- in engineering school when you model a beam and you talk about shear and bending, you first learn -- you basically assume that the bending is in the flanges and the shear is in the web and that's how you begin to model and analyze beams in

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engineering school, right?
MR. COOPERMAN: Objection to the form of the question.
THE WITNESS: Not entirely, no.
BY MR. LEAVELL:
Q. Okay. So in your declaration when you say there's no such thing as a non-beam side, there are such things as gondolas that have sides but no web; do you agree with that?
MR. COOPERMAN: Objection to the form of the question. Objection, calls for a legal conclusion.
THE WITNESS: Yes, I would say that's true.
BY MR. LEAVELL:
Q. So if we assume that a beam has to include a web --
A. I don't make that assumption.
Q. I know. I know.
But if we assume that the proper definition of the word "beam" includes the requirement of a web, then under that assumption, it's true that not all gondolas have beam sides under that assumption, right?

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MR. COOPERMAN: Objection to the form of the question. Objection, calls for a legal conclusion and no foundation.
THE WITNESS: If you made that definition of a beam saying that it has to include a web, then -- which is not correct, then that would lead you to say that some cars that don't have structural webs do not have -- do not have side beams. Well, again, that's -- that is based on an incorrect assumption.
MR. COOPERMAN: Mr. Leavell, we've been going for, I think, an hour. So at some point, let us know when it's convenient to take a break.
MR. LEAVELL: If the witness needs a break, please speak up, Mr. Dawson. I'm happy to take a break.
I was kind of hoping we could get to the lunch break because we had such a long break last time.
MR. COOPERMAN: And the long break last time was because of the technical issues obviously. I know at least I could use a --

at least a three-minute break.
MR. LEAVELL: Okay. That's fine. We can -- let me see if I'm ready to move on. If I am, I'll be happy to --
MR. COOPERMAN: Fine. Thanks.
MR. LEAVELL: Why don't we take the break now.
MR. COOPERMAN: Great.
MR. LEAVELL: Let's try to make it three minutes knowing it would be five.
MR. COOPERMAN: Okay.
MR. LEAVELL: Thank you.
(Whereupon, a recess was had from 11:35 a.m. to 11:42 a.m.)
MR. LEAVELL: Back on the record.
BY MR. LEAVELL:
Q. So, Mr. Dawson, what's the difference between a truss and a beam?
A. A truss is a type of beam.
Q. Does a truss have a web?
MR. COOPERMAN: Objection to the form of the question. Objection, calls for a legal conclusion.
THE WITNESS: It may or may not.

BY MR. LEAVELL:
Q. Would you agree that a beam is a member of a structure that carries load or loads transverse to its length?
MR. COOPERMAN: Objection to the form of the question. Objection, calls for a legal conclusion.
THE WITNESS: A beam is a structure that supports loads that are applied transverse to its primary axis.
BY MR. LEAVELL:
Q. And do you agree that beams resist flexure or bending and shear and sometimes torsion introduced by transverse loads?
A. Yes.
Q. Do you believe that a beam is a structural member intended to primarily resist transverse forces and subject to bending by these forces?
MR. COOPERMAN: Objection to the form of the question. Objection, calls for a legal conclusion.
Do you want the question read back?

THE WITNESS: Yeah, yeah, let's do that.
(The reporter read the record as requested.)
MR. LEAVELL: Subject.
THE COURT REPORTER: Yes, subject.
Sorry.
THE WITNESS: Yeah, I would say "and is subject to the forces."
Yes, I'd say that's true.
BY MR. LEAVELL:
Q. Is it true that a beam is a structural element that resists loads applied transversally to its axis by carrying shear forces and bending moments?
MR. COOPERMAN: Objection to the form of the question. Objections, calls for a legal conclusion.
THE WITNESS: Yes, I would say that's true.
BY MR. LEAVELL:
Q. Would you agree that a web is part of a beam that carries shear force?
MR. COOPERMAN: Objection to the form

of the question. Objection, calls for a legal conclusion.
THE WITNESS: A web is a part of the beam that carries shear forces.
BY MR. LEAVELL:
Q. Railcars can have sides that are framed that result from side post, corner post, bottom side chord, top side chord that can connect together to form a frame, right?
MR. COOPERMAN: Objection to the form.
MR. LEAVELL: Let me rephrase. Let me rephrase that. I'll withdraw the question.
BY MR. LEAVELL:
Q. Let me rephrase that, sir. Okay? Are you ready?
A. Go ahead.
Q. Some railcars have side assemblies in the form of a frame.
Do you agree with that?
A. Obviously, this would depend on what you mean by "a frame." But if by that you mean an assembly of separate components, then, yes, some freight car sides -- many freight car sides do -- do exist as frames.

Q. And there are railcars with side assemblies in the form of a frame that do not have webs, right?

MR. COOPERMAN: Objection to the form of the question. Objection, calls for a legal conclusion.

THE WITNESS: Yes. If by "web" we mean a load carrying member, some railcar sides do not have webs.

BY MR. LEAVELL:

Q. And in some conventional railcars with frame designs, the side sheets are often surface covers and do not contribute to supporting the bending load, right?

MR. COOPERMAN: Objection to the form of the question. Objection to the extent it calls for a legal conclusion.

THE WITNESS: Again, I'm not used to hearing the term "surface covers" used frequently in describing freight car sides. But there are sides in which the -- well, wait a minute.

Could -- could we go back? Could we have the question repeated, read back?

MR. LEAVELL: Sure.

(The reporter read the record as requested as follows:

"Q And in some conventional railcars with frame designs, the side sheets are often surface covers and do not contribute to supporting the bending load, right?")

THE WITNESS: Unless we consider single wooden sheets, like plywood sheets, as side sheets, then -- then all side beams have webs. But if we -- but if we consider sides with plywood side sheathing, those beams would not have webs.

BY MR. LEAVELL:

Q. Do you agree or disagree that there are frame-type railcars that have conventional side sheets made out of metal that are surface covers that do not contribute to supporting a bending load?

A. No.

MR. COOPERMAN: Objection to the form of the question.

BY MR. LEAVELL:

Q. Do you agree that there are conventional side sheets made out of metal that are merely surface covers and do not contribute to supporting the bending load?

MR. COOPERMAN: Objection to the form of the question.

THE WITNESS: No, I don't.

BY MR. LEAVELL:

Q. So in your opinion and as you discuss the patents at issue in this case, it's your opinion that every side sheet, unless it's made out of wood, must contribute to supporting the bending load?

MR. COOPERMAN: Objection to the form of the question.

THE WITNESS: Yes, that's correct.

BY MR. LEAVELL:

Q. On Page 16 of your declaration, paragraph 32, you state that: A person having ordinary skill in the art would understand the term "web" to be "the thin part of a beam extending from a top and/or bottom chord."

Do you see that?

A. I do.

Q. And that construction, is that a construction that you came up with or is that a construction the lawyers provided to you and asked you to opine whether it was correct?

A. I think that's one of those cases where we had discussion between myself and the lawyers before finally agreeing on the final wording.

Q. And that discussion would have taken place back in October or November when you were preparing the declaration?

A. Yes.

Q. It's your testimony that sometime in October and November, you had a conversation with the lawyers, and it was a collaborative effort where you guys came up with this definition of web, is that correct?

A. That -- yes, it is.

Q. Is the same true about the meaning for beam that you put in your report?

MR. COOPERMAN: Objection to the form of the question.

THE WITNESS: Yes, I believe it is true.

BY MR. LEAVELL:
Q. Is it your testimony that that's true about all of the definitions that you render opinions on in your declaration, that that was a collaborative effort to come up with those definitions between you and the attorneys, and you did that sometime in October, November?
MR. COOPERMAN: Objection to the form of the question, compound at least.
THE WITNESS: There may have been cases in which the original wording was accepted -- acceptable and there was no need for further discussion about it. I can't, as I sit here today, tell you which definitions in the declaration fit in that category.
BY MR. LEAVELL:
Q. And by "that category," that would be definitions that the lawyers already had and gave to you and asked you to adopt, right?
MR. COOPERMAN: Objection to the form of the question.
THE WITNESS: Yes, those would be cases in which the lawyers had developed definitions, which, as I reviewed them, I

considered to be acceptable and did not need to be revised.
BY MR. LEAVELL:
Q. But that's not -- there were some cases where that wasn't the situation and it's your testimony that the definition in your declaration was a result of collaboration with you and the lawyers, right?
MR. COOPERMAN: Objection to the form of the question. And objection, asked and answered.
THE WITNESS: Yes, that was true of some of the definitions.
BY MR. LEAVELL:
Q. About how many? Half, more than half where there was collaboration?
A. I really couldn't give you a figure.
Q. Other than beam and web, do you know of any others where your testimony is that there was collaboration?
MR. COOPERMAN: Objection to the form of the question. Objection, asked and answered.
THE WITNESS: I'd have to look through

it, which I'm doing now.
BY MR. LEAVELL:
Q. That's okay. I'll withdraw the question. We'll come back to that later if we have time.
A. All right.
Q. What does thin mean in your definition of web --
A. Thin --
Q. -- the thin part of a beam?
A. Obviously, it's a relative term and not a precise term.
Q. What's the -- I'm sorry. Go ahead.
A. So it would be -- it would mean having less -- lesser width than the -- than other parts of the beam.
Q. So if you have an I-beam with an upper horizontal portion, a lower horizontal portion, and a vertical web, you say the web has to be thinner than the other two pieces, relatively speaking? Is that what you're saying?
A. In this -- well, again, in this context, I'm talking about the width of the beam. It's conceivable that you would have a beam in

which the top and bottom flanges are half an inch thick and the web is five-eighths of an inch thick, but it's -- so while it is thicker than the flanges, it is still narrower than the flanges when measured in the transverse direction.
Q. What if you have an H-beam? Then the web is going to be wider in the transverse direction than the flange is, right?
A. Not necessarily.
Q. You could -- if you assume the same thickness for the two -- the left and the right flange and the web, horizontal web, the web is going to be wider than the flange or flanges?
A. It could be --
MR. COOPERMAN: Objection. Objection to the form of the question.
You can answer.
THE WITNESS: It would be -- it could be thicker than the webs -- than the flanges, but it would not be wider than the flanges. I'm measuring -- when I'm talking about being thin relative to the other portions of the beam, I'm talking about a measurement made in the same direction for all three components.

BY MR. LEAVELL:
Q. Right. So if you have an H-beam, what direction are we talking about?
A. It would be transverse to the axis of the web. An H -- an H-beam can be oriented vertically or horizontally any way that you want.
Q. Right. But if you have an H-beam that's oriented so that it looks like an H, you've got vertical flanges and a horizontal web in between them.
A. All right.
Q. In that case, the web is wider than the flanges, right?
A. No, it's not.
MR. COOPERMAN: Objection --
THE WITNESS: No, it's not.
MR. COOPERMAN: -- to the form -- Mr. Dawson, please pause and allow me to jump in with objections, if necessary.
Objection to the form of the question.
You can answer.
THE WITNESS: No, it's not because, again, I'm talking about width relative to

the axis of the web.
And so if you rotate an H-beam, which in structural parlance typically would be called a wide flange beam, even if you rotate it 90 degrees, the web is still narrower than the flanges. You're just measuring them in a different dimension.
BY MR. LEAVELL:
Q. Okay. So then explain to me in your own words how I determine whether something in a beam is thin enough to be a web.
A. It would be thin enough to be a web if it is -- if its width is less than that of the flanges.
Q. And when you say "width," we're not talking about the thickness; we're talking about the width?
A. No, no, we're not. We're talking about the -- the dimension or the orientation that is transverse to the axis of the web.
So if you had a beam with five-inch wide by half-inch thick top and bottom flanges and you had a web connecting the two flanges that was three-quarters of an inch thick, the web is

thicker than the flanges, but it is still thin relative to them because we're measuring in the same transverse direction for all three elements.
(Exhibit 0002 was marked for identification.)
BY MR. LEAVELL:
Q. In the '519 patent in the accused railcars, there are beams, webs running all different directions, right?
MR. COOPERMAN: Objection to the form of the question.
Janet, could you please read that back.
MR. LEAVELL: Let me rephrase it.
BY MR. LEAVELL:
Q. If you think of a car with a center sill and crossbearers, you've got the center sill running longitudinal, you've got the crossbearer running laterally, what direction do we use to measure the width of the webs in that case?
A. In each --
MR. COOPERMAN: Objection to the form -- objection to the form of the question. Objection, calls for a legal

conclusion.
You can answer.
THE WITNESS: In each case you would measure it transverse to the axis of the web.
So, therefore, when we're talking about the center sill which extends longitudinally, we would be measuring the width or thickness of the center sill webs transversely to the webs, which would also be transversely to the longitudinal orientation of the car.
When we think about the webs of the crossbearers which run transversely to the axis of the car, in this case we would be measuring the width, the thickness of the webs transverse to their axis, which would be longitudinally relative to the car as a whole.
BY MR. LEAVELL:
Q. If you could look at your Figure 10 on Page 17 of your declaration, your paragraph 33.
A. All right.
Q. In paragraph 33 of your declaration you have Figure 10. It's an example of an I-beam and

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a T-beam. And you've labeled those diagrams bottom chord, top chord, and web, and the last top chord --

THE COURT REPORTER: Wait. I'm sorry.

MR. LEAVELL: Is that too fast?

THE COURT REPORTER: Just for a second. And you've labeled those diagrams?

MR. LEAVELL: I'll start over.

THE COURT REPORTER: Thanks.

BY MR. LEAVELL:

Q. On Page 17, paragraph 33 of your declaration, there's Figure 10, right, sir?

A. Yes.

Q. And on the left, there's an I-beam, and you've labeled top chord, bottom chord, and web, right?

A. Right.

Q. On the right, there's a diagram, top chord and web, for a T-beam, right?

A. Yes.

Q. Did you create these diagrams and labels or did the lawyers create them for you?

MR. COOPERMAN: Objection to the form of the question.

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THE WITNESS: I believe the lawyers found them online somewhere.

BY MR. LEAVELL:

Q. Did the lawyers add the labels, top chord, bottom chord, top chord --

MR. COOPERMAN: Objection -- objection to the form of the question.

THE WITNESS: I really don't know. I --

BY MR. LEAVELL:

Q. Did you look --

A. -- suspect that they were on the diagrams when they accessed them, but I don't know that for a fact.

Q. And when you wrote your declaration and you formed your opinions, you assumed that the reference material from where the lawyers got these diagrams labeled them or called them top chord, bottom chord, right?

MR. COOPERMAN: Objection to the form of the question.

THE WITNESS: It really doesn't matter who applied the label to the diagrams. When I saw them, the labels were already applied,

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and I agreed with them.

BY MR. LEAVELL:

Q. And you assumed when you saw them that the source material, the NSS -- NSSCO.com, included those labels, right?

MR. COOPERMAN: Objection, asked and answered.

THE WITNESS: I -- I assumed it but didn't know it for a fact.

BY MR. LEAVELL:

Q. Did you ever look at the NSSCO.com website yourself?

A. No.

Q. Did you ever ask the lawyers to print it out and show it to you?

A. No.

Q. Do you know what the NSSCO stands for?

A. No, I don't.

Q. Did you find that website or did somebody else find that website and give you these diagrams?

A. I did not find it, no. Someone else found it.

Q. Have you reviewed the asserted claims

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and the patents in this case?

MR. COOPERMAN: Objection to the form of the question.

THE WITNESS: When you say "the asserted claims," what do you mean by that?

BY MR. LEAVELL:

Q. The claims that we are -- that NSC is alleging to be infringed by Greenbrier and which the Court is trying to construe.

A. I believe I have reviewed them, yes.

Q. Do you know whether any of the asserted claims use the term "chord"?

A. At this point, I don't remember whether any of them do or not.

Q. Did you review the claims when reaching your opinions and preparing your declaration here with respect to the meaning of web on Page 17 of your declaration?

MR. COOPERMAN: Objection to the form of the question.

Could you read that one back, please, Janet?

MR. LEAVELL: I'll rephrase it. It was a bad question.

BY MR. LEAVELL:
Q. Mr. Dawson, when you were forming the opinions on Pages 16 and 17 and 18 and 19 of your declaration and 20 and 21 regarding web, did you take into account the language of the asserted claims in this case?
MR. COOPERMAN: Objection to the form of the question.
THE WITNESS: No, I did not.
BY MR. LEAVELL:
Q. Were you aware that the term "chord" is used zero times in the asserted claims?
MR. COOPERMAN: Objection to the form of the question.
THE WITNESS: I -- I never noticed it.
BY MR. LEAVELL:
Q. Did you ever notice how many times the word "flange" is used in the asserted claims?
A. I did not count them, the times.
Q. Did you review the claim -- the asserted claims to see whether they used the term "flange" or "chord" when referring to the top and bottom pieces of the crossbearer and the center sill?

MR. COOPERMAN: Objection to the form of the question. Objection, calls for a legal conclusion.
THE WITNESS: No, I did not.
BY MR. LEAVELL:
Q. Did you read the specification of the asserted patents to see how they referred to those components and whether they referred to them as chords or flanges?
MR. COOPERMAN: Objection to the form of the question.
THE WITNESS: I did read the specifications but not with the objective of seeing what terms they did and did not use and much less how frequently they were used.
BY MR. LEAVELL:
Q. Do you know whether the term "chord" was used in the specification with respect to anything other than top chord?
MR. COOPERMAN: Objection to the form of the question. Objection, calls for a legal conclusion.
THE WITNESS: No, I don't -- I don't recall that.

BY MR. LEAVELL:
Q. Were you aware that once you get to the description of the invention, the patents, that the term "chord" is only used in the context of the top chord and not the center sill or crossbearer or cross-member or cross-tie? Did you ever consider that in forming your opinions?
MR. COOPERMAN: Objection to the form of the question. Objection, calls for a legal conclusion.
THE WITNESS: No, I didn't.
BY MR. LEAVELL:
Q. Did you consider when forming your opinions whether the specifications of the asserted patents used the term "flange" when talking about the parts of the center sill, crossbearer, knee, stiffener, and side posts that cooperate with the web?
MR. COOPERMAN: Objection to the form of the question. Objection, calls for a legal conclusion.
THE WITNESS: No, I did not.
BY MR. LEAVELL:
Q. Would it surprise you to learn that the

word "flange" is used 238 times in the specification?
MR. COOPERMAN: Objection to the form of the question.
THE WITNESS: Nothing would surprise me about patent language.
BY MR. LEAVELL:
Q. When it comes to crossbearers and bolsters, would you use the term "top plate" and "bottom plate" to refer to the structures on top and bottom of the webs or would you refer to those as chords?
MR. COOPERMAN: Objection to the form of the question. Objection, calls for a legal conclusion.
THE WITNESS: It would depend on the context. I would typically not use the terms top and bottom plate. But with body bolsters, I frequently use the terms top cover plate, bottom cover plate. With crossbearers, I might use top plate, bottom plate. I might use top flange, bottom flange. I would say that it would vary.
///

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BY MR. LEAVELL:
Q. I'm going to introduce the next exhibit, which I think is 10.
A. Let me see if I can access that.
Q. Well, let's do this. This will be easy. It's a one-pager. Let's do the screen share for this. We'll break for lunch soon and you can work on it then. Okay?
A. All right.
(Exhibit 0010 was marked for identification.)
BY MR. LEAVELL:
Q. All right. Do you have Exhibit 10 on your screen, sir?
A. Yes.
Q. And can you see it?
A. I can.
Q. Do you recognize this? Do you know where it's from?
A. Well, it's obviously an illustration from a patent. At this point, I don't recall which patent.
Q. This is a figure from the asserted patents.

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A. One of the asserted patents?
Q. The figures are the same in both patents.
A. Okay.
Q. So it's in both patents.
And the figure on the left of Exhibit 10 is Figure 7, I think. But they're figures from the asserted patent.
Did you consider these figures when forming your opinions and rendering and preparing your declaration?
A. Well, I've certainly seen them before.
Q. Okay. See the item I've highlighted in yellow on Exhibit 10?
A. Yes, yes.
Q. Am I correct that you would consider that to be a side sill, not a web?
MR. COOPERMAN: Objection to the form of the question. Objection, calls for a legal conclusion. Objection, no foundation.
THE WITNESS: Yes, I -- I would -- I would consider that a -- a side sill and not part of the web of the side assembly.
MR. LEAVELL: Bear with me a moment.

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(A pause was had in the proceedings.)
BY MR. LEAVELL:
Q. Turning back to your report, your Figure 10 on Page 17.
A. All right.
Q. In the I-beam and T-beam that you've shown there, if we assume that the load is applied vertically against the top portion, which you've referred to as the top chord, the shear in the web is going to be in the web itself, right?
A. Well, if you're talking about the shear in the web, by definition it has to be in the web itself.
Q. Right. And it would be -- you model it as running vertically between the top chord and bottom chord on the I-beam you've shown, right?
MR. COOPERMAN: Objection to the form of the question.
THE WITNESS: I'm not sure I understood what you meant in that question.
BY MR. LEAVELL:
Q. Okay. Well, let me -- if you can keep your finger on that diagram, Figure 10.

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A. All right.
Q. And then also I want to have you look at your Figure 24 on Page 28.
A. All right.
Q. And the Figure 24 on Page 28, that's where you describe tension, compression, and shear?
A. Yes.
Q. And this tension, compression, and shear diagram, Figure 24, that's another diagram that the lawyers pulled from a website, right?
MR. COOPERMAN: Objection to the form of the question.
THE WITNESS: They pulled it from somewhere. I don't know whether it was a website or where. But, yes, they came up with that -- with that diagram in Figure 24.
BY MR. LEAVELL:
Q. You've never been to the commons.wikimedia.org website cited on the bottom of Page 28, have you?
A. No.
Q. Now, when I first looked at Figure 24, I was somewhat confused because it looked like --

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I couldn't figure out what you were trying to imply here.

With the -- I mean, I guess -- the force, if it's shear force -- shear force as you show on the right on Figure 24, do you see that?

A. Yes.

Q. Figure 24, when it shows the shear force, the shear force is not applied externally to the member as shown in this Figure 24, right?

MR. COOPERMAN: Objection to the form of the question.

THE WITNESS: Typically not.

BY MR. LEAVELL:

Q. If you're talking about an I-beam, the shear is not an external force being applied to the web; it's a shear stress that exists in the material of the web, right?

MR. COOPERMAN: Objection to the form of the question.

THE WITNESS: No, there are -- there are shear forces or whatever. They result from -- I mean, shear is a somewhat difficult concept. But they -- at any point in -- along the length of a beam, there are shear

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forces resulting from the external loads applied to the beam, but there are also shear stresses in the beam at different points in the beam as well.

Perhaps one way of looking at it is if -- yeah. So if we take a particular location along the length of a beam, there will be one value of shear force at that location. But if we look at the cross-section of the beam at that same location, there will be variations in shear stress as we move along the height of the beam.

BY MR. LEAVELL:

Q. In the context of, for example, a crossbearer on a railcar, the shear is not going to be as shown in this Figure 24 on Page 28 of your report?

A. Well, no. The --

MR. COOPERMAN: Objection to the form of the question.

You can go ahead and answer.

THE WITNESS: The -- obviously, the diagrams in Figure 24 are very simplified.

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And in the case of a crossbearer, particularly if you have longitudinal floor stringers above it or, for that matter, connecting to it, there will be -- no, there will be external forces applied at each of those floor stringers as well as at the side of the car and at the connection of the crossbearer to the center sill. And so the amount of shear force at each location in the center sill will vary depending on each of those locations.

BY MR. LEAVELL:

Q. But by definition, shear force or shear stress of the web of an I-beam is in the -- in the web itself?

A. Well --

MR. COOPERMAN: Objection -- objection to the form of the question. Objection to the extent it calls for a legal conclusion.

THE WITNESS: Well, by definition, shear force in the web is in the web. The shear force in the beam, however, is not solely in the web. You need to make a distinction between the beam and the web.

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BY MR. LEAVELL:

Q. Do you agree that in the context of the asserted National Steel Car patents, that it may be assumed that each web member provides a shear connection between the flange members and that those flange members carry the bending moment reaction?

MR. COOPERMAN: Objection to the form of the question. Objection, calls for a legal conclusion.

Do you need that one back, Dick?

THE WITNESS: Well, he's saying in the context of the patents, and I would have to look at how they are stated in the patent in terms of answering the first half of the question, which related to the shear force.

Insofar as the second portion of the question where he is referring to the -- I think you referred to bending stresses and said that they are in the top and bottom chords, and my response to that is they are not solely in the top and bottom chords.

BY MR. LEAVELL:

Q. So is that -- I'll ask you it again.

So I think what you -- based on your prior answer, then you disagree with the statement that it may be assumed that each web member provides a shear connection between the flange members and that those flange members carry the bending moment reaction?

THE COURT REPORTER: The bending what?

MR. COOPERMAN: Objection to the form of the question.

Sorry.

THE COURT REPORTER: The bending what?

MR. LEAVELL: Bending moment reaction.

MR. COOPERMAN: You got it, Janet?

MR. LEAVELL: Let me re-ask it.

THE COURT REPORTER: Bending --

MR. LEAVELL: Let me re-ask it. I'll expect your objection.

Mr. Dawson, don't start speaking until he's done with his objection.

Everybody ready?

THE WITNESS: All right. Well, first off, I mean --

MR. COOPERMAN: No. Dick, there's no question. Wait for the question.

THE WITNESS: Okay. If he's going to restate the question, then that's fine. Let's do that.

MR. COOPERMAN: Yes.

BY MR. LEAVELL:

Q. So, Mr. Dawson, do you disagree with the following statement in the context of the NSC asserted patents: It may be assumed that each web member provides a shear connection between the flange members and that those flange members carry the bending moment reaction?

MR. COOPERMAN: Objection to the form of the question. Objection, no foundation. And objection, calls for a legal conclusion.

THE WITNESS: Well, that is really two questions. One of them is: Do we assume that the -- that the webs provide a shear connection to the flanges? That's question number one.

And question number two -- and I don't know whether the assume part carries over, but question number two is whether the flanges carry -- I think it was -- was it bending stresses, I think was the way that it

was worded?

BY MR. LEAVELL:

Q. Bending moment reaction.

A. Bending moment reaction.

So I'll answer the second one first, which is that the flanges do solely carry the bending moment reactions.

As far as -- or, again, you're saying in the context of the patent, can we assume that the web provides a shear connection to the flanges? And I would say, yes, we can.

MR. LEAVELL: Would now be a good time to break for lunch?

MR. COOPERMAN: Sure. Can we take 45 minutes?

MR. LEAVELL: Sure.

(Whereupon, from 12:32 p.m. to 1:19 p.m. a luncheon recess was taken.)

* * * * *

AFTERNOON SESSION

RICHARD DAWSON,

was called for examination, and having been previously duly sworn, was examined and testified further as follows:

EXAMINATION (Resumed)

BY MR. LEAVELL:

Q. Welcome back, Mr. Dawson.

During the lunch, did you discuss the substance of your testimony with anyone?

MR. COOPERMAN: So I'm going to caution you again, Mr. Dawson, that the conversations that you had with counsel about your testimony are privileged. If you had other conversations, feel free to talk about them.

BY MR. LEAVELL:

Q. So, yes or no, Mr. Dawson, did you have conversations during the lunch break about the substance of your testimony?

A. About the substance of my testimony, no.

Q. What did you talk about over lunch?

A. Well, we talked about my getting access back to the exhibits, which I think can be

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helpful. And I think that was basically it. It was a very brief discussion.
Q. Okay. So do you have access to the file share now?
A. Yeah, I'm pretty sure I do.
Q. So if you go into the marked exhibits folder, you can see Exhibits 1 through 10?
A. Yeah, let me make sure that I can. Oh, no, that's not what I want.
I'm there.
Yes, right. So right now I'm looking at Exhibit -- I was looking at Exhibit 4.
Well, I only -- I'm only seeing four exhibits. So I don't why -- I know you've put others up since then, so I'm not sure why I'm not seeing them.
MR. COOPERMAN: Do you see a back button, Dick, like right above the list of the exhibits?
THE WITNESS: Oh, yeah, yeah.
MR. COOPERMAN: If you hit the back button once, it may bring you up a level and then refresh, and then you can go back into the directory.

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THE WITNESS: I'm not seeing refresh. If I go back to marked exhibits -- oh, there they are.
MR. COOPERMAN: Great.
THE WITNESS: So I've got Exhibits 1 through 10.
BY MR. LEAVELL:
Q. All right. Fabulous.
Mr. Dawson, you're familiar with The Car and Locomotive Cyclopedia, right?
A. I am.
Q. And would you agree it's honored in the industry?
A. Yes, I would say that it's honored.
Q. Would you agree that it's one of North America's major sources of railroad mechanical/ technical information?
A. Well, they certainly say that. But, yeah, for the most part I would say that's true.
Q. Would you agree that the Cyclopedia serves as a complete resource for individuals working in and simply interested in the railroad industry?
MR. COOPERMAN: Objection to the form

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of the question.
THE WITNESS: I'd say that the description as a complete resource implies a greater degree of coverage than what is actually in there, but I would certainly consider it a valuable resource.
BY MR. LEAVELL:
Q. In fact, at the time that the NSC patents were filed, the current edition of the Cyclopedia was the 6th Edition which had been published in 1997.
Do you understand that?
A. Yes, it is, yes. And, in fact, it's still the current edition.
Q. And you actually wrote one of the chapters in that edition, didn't you?
A. I did.
Q. When you formed the opinions in your declaration and wrote your declaration, did you refer to the Cyclopedia at all?
MR. COOPERMAN: Objection to the form of the question.
THE WITNESS: Yes, we did -- we did consider what was in the Cyclopedia.

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BY MR. LEAVELL:
Q. When you formed your opinions in this case and prepared your declaration, did you know one way or the other whether the portions of the Cyclopedia were submitted to the patent office during examination of the asserted patents?
MR. COOPERMAN: Objection, no foundation.
THE WITNESS: I certainly was unaware of it, if it was.
BY MR. LEAVELL:
Q. Do you agree that the Cyclopedia is a particularly useful resource to those in the industry of railcar building?
MR. COOPERMAN: Objection to the form of the question.
THE WITNESS: Yes, I would consider it a useful resource.
BY MR. LEAVELL:
Q. Do you agree that the Cyclopedia serves as a reliable source of information to those in the industry?
A. Reliable as in always correct, I would not say that.

Q. Well, something could be reliable without being 100 percent correct all the time, right?
MR. COOPERMAN: Objection to the form of the question.
THE WITNESS: Yeah, I guess that's true.
BY MR. LEAVELL:
Q. Are you aware of any other dictionary of railcar terminology?
A. I believe Simmons-Boardman publishes one, but in fact, if I'm not mistaken, it is just the dictionary section from the Cyclopedia reprinted in a different form.
Q. Simmons-Boardman is the publisher of the Cyclopedia as well, right?
A. It is, as well as Railway Age Magazine and one or two other railway -- railroad journals.
Q. Other than the Cyclopedia and maybe this other copy in a different form of the Cyclopedia's dictionary, are you aware of any other dictionary of railcar terminology from the late '90s or early 2000s?
A. I really can't think of any.

Q. And you didn't resort or rely on any or refer to any while forming your opinions in this case or preparing your declaration, anything other than -- any other dictionary of railcar terms other than the Cyclopedia, did you?
MR. COOPERMAN: Objection to the form of the question.
THE WITNESS: No, I did not.
BY MR. LEAVELL:
Q. Now, in your declaration, you talk about the definition of a center sill as a center longitudinal structural member of the underframe that transmits longitudinal forces from one or both couplers.
That's your opinion of the meaning of center sill, right?
MR. COOPERMAN: Objection --
THE WITNESS: Yes.
MR. COOPERMAN: -- to the form of the question.
Mr. Dawson, you need to pause.
THE WITNESS: You're right.
BY MR. LEAVELL:
Q. And was this one of the definitions

that the lawyers provided to you or is this one that you collaborated on with them in October or November?
MR. COOPERMAN: Objection to the form of the question.
THE WITNESS: I believe we collaborated on this one.
BY MR. LEAVELL:
Q. And the time of that collaboration would have been as you were preparing your declaration in October or November?
A. Yes.
Q. Now, the phrase "transmits longitudinal forces from one or both couplers," that means that, in your opinion, a center sill can transmit longitudinal forces from only one coupler and not both, right?
A. That's correct.
Q. That definition of center sill, which would allow for transmitting longitudinal forces from one but not both couplers, that is inconsistent with the Cyclopedia definition which talks about transmitting most of the buffing shocks from one end of the car to the other,

right?
MR. COOPERMAN: Objection to the form of the question.
THE WITNESS: Yes, it is inconsistent with their definition.
BY MR. LEAVELL:
Q. The Cyclopedia does not say that a stub sill is a type of center sill, does it?
MR. COOPERMAN: Objection to the form of the question. Objection, no foundation.
THE WITNESS: I have to go back and look at their definition to determine whether it makes -- indicates that it is completely separate from a center sill.
BY MR. LEAVELL:
Q. NSC's construction of center sill is consistent with the Cyclopedia definition, right?
MR. COOPERMAN: Objection to the form of the question. Objection, no foundation.
THE WITNESS: As best I recall NSC's construction, yes, it is.
BY MR. LEAVELL:
Q. In paragraph 42 of your declaration on Page 22, can you turn to that, please?

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A. Yes.
Q. On the bottom of Page 22 of your declaration, there's a Figure 17, right?
A. Yes.
Q. And do you know where this figure comes from?
A. Off the top of my head, no.
Q. Was this a figure that you found and decided to include, or was this a Figure 17 that the lawyers provided for you and asked you to include in the declaration?
A. I believe that the lawyers came up with -- with that drawing.
Q. Do you know what the name of the car that is represented by this Figure 17 is?
A. Off the top of my head, no.
Q. When you were forming your opinions and preparing your declaration, did you review any materials that were prepared by the individuals who designed this car?
MR. COOPERMAN: Objection to the form of the question.
THE WITNESS: Since I don't know which car it is, I therefore don't know who

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designed it and unaware that I refer to any materials that they had developed, although it's conceivable that I did without knowing that they were the designer of this car.
BY MR. LEAVELL:
Q. There's nothing listed in the materials you reviewed in your declaration that relate to this car, other than perhaps Greenbrier's preliminary invalidity contentions, is that correct?
MR. COOPERMAN: Objection to the form of the question.
THE WITNESS: Well, again, since I don't recall where this diagram came from or what car it represents, I can't really state whether or not any of the documents listed in paragraph 10 of my declaration include this car.
BY MR. LEAVELL:
Q. If you had reviewed plans or documents or memos --
THE COURT REPORTER: Wait. Wait. You are soft spoken, so I have to put you up.
I'm sorry. Go ahead.

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BY MR. LEAVELL:
Q. Mr. Dawson, if you had reviewed any materials written by the engineer or engineers who designed the car shown in your Figure 17 while forming your opinions and preparing your declaration, you would have included that in the list of materials reviewed, right?
MR. COOPERMAN: Objection to the form of the question.
THE WITNESS: If we're talking about how I came up with the definition of center sill, this was something that was already firmly established in my mind based on my prior experience and I did not feel the need to consult any other material in developing my opinion.
This diagram is shown here solely as an illustration of a stub center sill and really has nothing to do with I came up -- how I came up with the defini- -- definition that appears in paragraph 42.
BY MR. LEAVELL:
Q. Do you have any understanding as to how the individuals who designed this design in

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Figure 17 of your report, how they refer to the car?
MR. COOPERMAN: Objection to the form of the question. Objection, no foundation.
THE WITNESS: Since I don't know who they are, obviously I can't have any opinion on how they would describe the center sills on this car.
BY MR. LEAVELL:
Q. Did you review any industry publications that discuss this design in Figure 17 of your declaration when forming your opinions and preparing your declaration?
A. No, not in the course of developing my opinions, no. I mean, I've seen many, many references to stub center sills over the years on a wide variety of car types, but I do not refer to any other material in developing my definition of center sill.
Q. Did you ask the lawyers whether they had any additional information about this design in Figure 17?
MR. COOPERMAN: Objection to the form of the question.

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THE WITNESS: I may have, but I don't recall doing so.
BY MR. LEAVELL:
Q. Is the Federal Railroad Administration a reputable industry organization?
A. Yes, I would say that it is.
Q. Is the ASME International Mechanical Engineering Congress and Exposition, is that a reputable conference in the railcar industry?
A. It has been over the years, yes.
Q. Was there a time where it was ill repute and not reputable?
A. No, I wouldn't say that. I mean, the -- what are they -- the ISCME [sic] or something along that line is the annual meeting of the ASME, which includes papers presented by a number of the technical divisions within the ASME, sometimes including the rail transportation division and sometimes not. But I would certainly consider it to be a reputable organization and the annual meetings to be reputable conferences.
Q. A person of ordinary skill in the art in 2005 would have been familiar with the Federal Railroad Administration, right?

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A. I'm sure -- I'm not sure I know what you mean by being familiar with the adminis- -- Federal Railroad Administration.
Q. Fair. Fair.
A person of ordinary skill in the art in 2005 would have considered -- would have known of the Federal Railroad Administration?
A. Definitely.
Q. A person of skill in the art in 2005 would have considered the Federal Railroad Administration to be reputable?
A. Yes, I would say so, even though such -- such a person might disagree with the -- with the FRA's views on some topics, but they would certainly consider it to be reputable.
Q. A person of ordinary skill in the art in 2005 would have known about the ASME International Mechanical Engineering Congress and Exposition, right?
A. Most certainly would.
Q. A person of ordinary skill in the art in 2005 would have known about The Car and Locomotive Cyclopedia?
THE COURT REPORTER: I'm sorry. Could

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you please just slow down a little?
MR. LEAVELL: Sure. I'll start over with that question. New question, new break, please.
THE COURT REPORTER: Thank you.
BY MR. LEAVELL:
Q. A person of ordinary skill in the art in 2005 would have known about The Car and Locomotive Cyclopedia, right?
A. I would say so.
Q. Now, in your declaration, you take issue with the use of the word "backbone" in the Cyclopedia's definition of center sill.
Do you recall that?
A. Yes, as I recall, I did.
Q. And in substance, you say that the center -- you take issue with the fact that the center sill is the backbone because the side beams may carry a predominant amount of the load as opposed to the center sill, right?
MR. COOPERMAN: Objection to the form of the question.
THE WITNESS: That's correct. To me, the term "backbone" imply that it provided

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the primary support for vertical load, which is true on some cars like flatcars and is not true on other types of cars, indeed most types of cars, including gondolas.
BY MR. LEAVELL:
Q. The proportion of the vertical load that's carried by the center sill as compared to the side walls is a function of the size of each of the components, right?
MR. COOPERMAN: Objection --
THE WITNESS: Right.
MR. COOPERMAN: -- to the form of the question.
BY MR. LEAVELL:
Q. If you have a very, very deep, big fishbelly center sill and short walls, then more of the vertical load would be carried by the center sill, right?
MR. COOPERMAN: Objection to the form of the question.
THE WITNESS: The distribution of the -- of support for the vertical loads is essentially governed by the stiffness of the sides and of the center sill. And, of

course, greater depth or heighth leads toward greater stiffness. And so the stiffer the sides are relative to the center sill, the greater is the proportion of the vertical load that they will support and vice versa.

BY MR. LEAVELL:

Q. When it comes to buffing shocks and transmitting buffing shocks from one end of the car to the other, the center sill will have a -- more of a role in that than the side walls in a gondola car, right?

MR. COOPERMAN: Objection to the form of the question. Objection, calls for a legal conclusion.

THE WITNESS: If, in fact, the car has a continuous through center sill, which most gondolas do, then the center sill will take a larger portion, probably a majority, of the longitudinal coupler force to which the car is subjected either in buff or in draft.

BY MR. LEAVELL:

Q. The buff is compression, draft is tension, but they're both the longitudinal forces pulling and pushing on the car from the car

coupled to it, right?

A. Correct.

MR. COOPERMAN: Objection to the form of the question.

Mr. Dawson, you need to pause to allow me to object.

THE WITNESS: Yep.

BY MR. LEAVELL:

Q. So when the Cyclopedia talks about the center sill being the backbone of the underframe, if we assume that it's talking in the context of transmission of buff and draft shocks, would you agree that that's a fair use of the word "backbone" by the Cyclopedia?

MR. COOPERMAN: Objection to the form of the question.

THE WITNESS: If we interpret backbone in that way and if we are talking about a car with a through center sill, then I would agree with that.

BY MR. LEAVELL:

Q. If we're talking about a car with stub sills, then the stub sills would not form the backbone of the underframe and transmit most of

the buffing shocks from one end of the car to the other, right?

MR. COOPERMAN: Objection to the form of the question.

THE WITNESS: That's right. Each of the two stub sills would accept all of the buffing force from the couplers, but it would then have to be sheared out to the remainder of the car body to carry those loads down to the other end of the car where they would then be sheared back into the other stub sill.

BY MR. LEAVELL:

Q. The asserted patents in this case, the National Steel Car patents, every figure in those patents shows a center sill that transmits the forces from one end and one coupler all the way down to the other end and the other coupler, right?

MR. COOPERMAN: Objection to the form of the question. Objection, calls for a legal conclusion.

THE WITNESS: Did you say that they carry the majority of the force from one end

to the other or did you say all of the force?

BY MR. LEAVELL:

Q. I don't recall. Let me re-ask the question.

Every figure in the asserted patents discloses a center sill that is a center longitudinal structural member of a railcar underframe which forms the backbone of the underframe for transmitting longitudinal forces, including buffing shocks, from each coupler to the other coupler, right?

MR. COOPERMAN: Objection to the form of the question. Objection, calls for a legal conclusion. And objection, no foundation.

THE WITNESS: Well, that -- the first part of that statement is that all of the figures in the two patents show gondola cars with continuous center sills. That may very well be true. At this point, my recollection of the two patents is not good enough to confirm that, but for purposes of answering this question I will assume that it is correct.

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So then the next part of the statement is that they serve as the backbone of the underframe in carrying butt forces from one end of the car to the other. And, again, if we interpret the word "backbone" to mean that the center sill carries most, but not all, of the longitudinal buffing forces from one end of the car to the other, then, yes, I would agree to that statement.

BY MR. LEAVELL:

Q. None of the figures in the asserted National Steel Car patents disclose a stub sill design, right?

A. I'd have to go back and look at the patents, but I do not recall either one of them referring to a car with stub sills.

Q. Do you recall whether you determined whether the word "stub" shows up in the specification or not? And if so, in what context?

MR. COOPERMAN: Objection, no foundation.

THE WITNESS: I don't recall.

BY MR. LEAVELL:

Q. Do you have any reason to believe that

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you did a word search for the word "stub" in the asserted patents?

A. I have every reason to believe that I did not do a word search for the word "stub" in the two patents.

Q. Did you do any word searching of the specifications looking for any particular words?

A. No.

Q. A draft sill is different than a center sill, right?

A. A draft sill is a portion of a center sill. At one time, going back to the 19th Century, draft sills were often separate components, somewhat like a modern-day stub sill.

But in current -- and by "current," I mean like within the past 50, 80 years or so -- the term "draft sill" is used to refer to the outer portion of the center sill, whether a through sill or a stub sill, that incorporates the components that house the coupler shank and transmit longitudinal coupler forces from the coupler to the draft sill/center sill.

Q. I'm going to introduce another exhibit, so hopefully you can see this one.

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(Exhibit 0011 was marked for identification.)

MR. COOPERMAN: You're going to need to refresh again, Dick.

MR. LEAVELL: Don't do it yet. Don't do it yet.

Okay. It should be viewable now.

THE WITNESS: There we are.

BY MR. LEAVELL:

Q. For the record, Exhibit 11 is U.S. Patent No. 5,360,125. This is a patent on which you are a co-inventor, right?

A. Yes.

Q. And this patent is on a drawbar connection, right?

A. That's right.

Q. And if you look through here -- I'll see if I can do a search.

So what's shown in the figures of your patent -- I'll try to --

A. All right. Any particular figure?

Q. No. I'll talk -- none of your figures -- all of your figures show a drawbar and a draft sill, right?

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MR. COOPERMAN: Objection to the form of the question.

THE WITNESS: They show the drawbar. They show the draft sill. And they show the other components that are used to connect the drawbar to the car body, both as portions of the draft sill and as loose components.

BY MR. LEAVELL:

Q. So is it fair to say what is shown in Figures 4 and 5?

A. All right. Let me get to them.

There's 4.

Q. 4 is on the same page as 5. They're both on the same page.

A. All right.

Q. Are you there?

A. Yes. On my screen, I only can get one at a time, but that's all right.

Q. Well, sheet 2 of 3 has both Figures 4 and 5 on it.

A. All right. Well --

Q. Maybe you need to zoom out a little bit. Do what you need to do to see it.

And one is a top --

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A. Yeah, I -- I don't see a means of affecting the zoom. Oh, wait a minute. Yes, I do. Yes, I do.

I'm going too fast there.

Well, it's really two different pages, but that's all right. I can get them both on here, although they end up being kind of small.

Q. I'm going to share my screen for a moment.

A. All right. I've got them here, so...

Q. Figure 4 is right here and Figure 5 is next to it all on the same page.

A. Yeah, not on what I'm seeing. I'm seeing them on two separate pages.

Q. You can use my screen share if you need to to see them both.

A. All right.

Q. But Figures 4 and 5 are showing the same thing from different views, right?

A. Well, Figure 5 -- let me make -- oh, wait a minute. That's Figure 6.

Oh, I see what it is. All right. Okay. 4 and 5, it's just a grand view and a side elevation.

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Q. Yeah.

A. Let me enlarge it. I didn't realize that they were both considered --

Q. I know. It can be tricky.

A. -- separate figures.

Q. Are you there, Figures 4 and 5?

A. Yes.

Q. Do you understand what's being shown here?

A. Yes.

Q. And what's being shown is a draft sill arrangement, right?

A. Right.

Q. And this would be a center longitudinal structural member of the underframe, right?

MR. COOPERMAN: Objection to the form of the question.

THE WITNESS: Right.

MR. COOPERMAN: Objection, calls for a legal conclusion.

Mr. Dawson, you need to pause.

THE WITNESS: Right.

So, yes, what we are seeing here is the draft sill portion of the center sill on the car.

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BY MR. LEAVELL:

Q. Where is the center sill shown?

A. Well --

MR. COOPERMAN: Objection to the form of the question. Objection, calls for a legal conclusion.

THE WITNESS: The draft sill is part of the center sill. So what we are seeing here is the outer portion of the center sill. I don't believe that the entire 89 feet length of the center sill is illustrated in the -- in the patent anywhere.

BY MR. LEAVELL:

Q. There's no depiction of anything other than the draft sill. And the word "center sill" doesn't appear anywhere in the patent. I'll represent that to you.

MR. COOPERMAN: Objection to the form of the question. Objection, no foundation.

THE WITNESS: Is there -- was there a question there?

BY MR. LEAVELL:

Q. Not yet.

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A. Okay.

MR. COOPERMAN: Sorry.

BY MR. LEAVELL:

Q. This structure that's shown in Figures 4 and 5 of your patent is a center longitudinal structural member of the underframe, right?

MR. COOPERMAN: Objection to the form of the question. Objection, calls for a legal conclusion.

THE WITNESS: So we are seeing that, we are seeing a portion of the center sill, along with a number of components that are enclosed within it.

BY MR. LEAVELL:

Q. Let's just talk about the components that are shown in Figures 4 and 5. All right?

A. Okay.

Q. That collection of components can fairly be characterized as a center longitudinal structural member of the underframe, correct?

MR. COOPERMAN: Objection to the form of the question. Objection, calls for a legal conclusion.

THE WITNESS: Those figures show more

than a portion of the center longitudinal structure of the underframe.
BY MR. LEAVELL:
Q. Would it be accurate or inaccurate to describe Figure 4 as showing a center longitudinal structural member of the underframe?
MR. COOPERMAN: Objection, asked and answered.
THE WITNESS: Figure 4 shows that and other components as well.
BY MR. LEAVELL:
Q. What's shown in Figure 4 can transmit longitudinal forces from one coupler but not both, right?
MR. COOPERMAN: Objection to the form of the question. Objection, calls for a legal conclusion.
THE WITNESS: Well, Figure 4, as indicated by -- by the wiggling lines at the top of the view, is only a portion of the center sill. And the entire center sill does transmit the forces from both couplers. Well, of course in this case, one end is a drawbar; the other end is a coupler.

What we -- the portion of the center sill that we see here only transmits longitudinal forces from, in this case, the drawbar as opposed to a coupler, and only one drawbar.
BY MR. LEAVELL:
Q. So Figure 4 doesn't show a center sill; it shows a portion of a center sill?
MR. COOPERMAN: Objection to the form of the question. Objection, calls for a legal conclusion.
THE WITNESS: Yes, Figure 4 shows a portion of the center sill on this car.
BY MR. LEAVELL:
Q. Not the entire center sill?
MR. COOPERMAN: Objection to the form of the question. Objection, calls for a legal conclusion.
THE WITNESS: That's right, not the entire center sill.
BY MR. LEAVELL:
Q. Okay. If you could turn to Page 23 of your declaration.
A. All right.

Q. In paragraph 44 of your declaration, you say: A person of ordinary skill in the art would normally understand the term "side sill" to mean "a dedicated lengthwise running member that acts as a bottom chord of the side beam," right?
A. Yes, that's what it says.
Q. Was this one of the constructions that you collaborated with the lawyers on in October and November or was this one that they gave to you?
MR. COOPERMAN: Objection to the form of the question.
THE WITNESS: Well, the original wording on this was, of course, provided by the attorneys. And I -- we're talking about the first sentence there. Yeah, I don't remember whether I had any comments on it and we made mutually agreed-upon revisions or not.
BY MR. LEAVELL:
Q. What does the word "dedicated" mean in the phrase "a dedicated lengthwise running member"?
A. I'm trying to recall.

I interpret it to mean that it is a -- a member that is intended to act as a bottom chord of the side beam.
Q. Can you give me an example of a lengthwise running member that acts as a bottom chord of a side beam but which is not a dedicated member?
A. No, not off the top of my head.
Q. When you formed your opinions and prepared your declaration, did you give any thought about the word "dedicated" in this or are you sort of coming up with that now?
MR. COOPERMAN: Objection to the form of the question.
BY MR. LEAVELL:
Q. And remember, sir, you're under oath.
MR. COOPERMAN: Objection to the form of the question. I'm not sure what that's supposed to imply.
Can you read the question back, please, Janet?
THE COURT REPORTER: Sure.
(The reporter read the record as requested as follows:

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"Q When you formed your opinions and prepared your declaration, did you give any thought about the word 'dedicated' in this or are you sort of coming up with that now?")

THE WITNESS: I don't recall the extent to which I gave much thought to the term "dedicated" in that definition.

BY MR. LEAVELL:

Q. Do you have any recollection of giving the term "dedicated" any thought at all?

MR. COOPERMAN: Objection to the form of the question.

THE WITNESS: I have no specific recollection of it.

BY MR. LEAVELL:

Q. Are you familiar with tank cars, sir?

A. Somewhat.

Q. You've seen tank cars with side sills, right?

MR. COOPERMAN: Objection to the form of the question. Objection, calls for a

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legal conclusion.

THE WITNESS: I'm not sure that I would -- if we talk about current construction in which the tank is the primary longitudinal structural member of the car, there are typically short longitudinal structures that run from the outer ends of the body bolsters to the end sills, but -- and in terms of whether or not they're called side sills, I suspect that sometimes they are and sometimes they're not. They certainly do not support any vertical load.

MR. LEAVELL: I'm going introduce the next exhibit. This will be Exhibit 12.

THE WITNESS: All right. So let me go out of here.

(Exhibit 0012 was marked for identification.)

BY MR. LEAVELL:

Q. For the record, Exhibit 12 is U.S. Patent No. 9,944,302. The inventor is Mr. Saxton. The assignee is Gunderson, which I'm sure, as you understand, Mr. Dawson, Gunderson is part of Greenbrier.

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A. Yes, I am.

Let me go back. I think I went up to refresh a little bit too soon. Let me see if I can get Exhibit 12 now.

I'm not seeing an Exhibit 12.

Q. You try for a minute and then I'll share my screen if you need me to.

A. All right.

MR. LEAVELL: Marc, Audra, do you have Exhibit 12? Are you able to get it?

MR. COOPERMAN: Yeah, I've got it.

MR. LEAVELL: Just wanted to make sure it wasn't this user error over here.

BY MR. LEAVELL:

Q. Mr. Dawson, I can share my screen again, if you'd like.

A. All right. Let's do that.

Q. Although I'm not sure how -- it's a little blurry. Let me know if we need to take a break and get it up there. Let's try this.

It looks like I'm already sharing.

Do you see that?

A. Yeah, I see it.

Q. Okay. And I'm going to draw your

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attention to column 3. And if you need to see the whole patent and read it, I'm happy to show you more or give you time. But let me just start by showing you the passage on column 3, lines 59 to 61.

All right. I've got the wrong cite. Sorry. Sorry. I'm on the wrong cite. I think it's at column 2, lines 14 to 22. I apologize.

THE COURT REPORTER: Can we go off the record for one minute?

MR. LEAVELL: Sure.

(Whereupon, a discussion was had off the record.)

MR. LEAVELL: Back on the record?

THE COURT REPORTER: Sure.

BY MR. LEAVELL:

Q. Mr. Dawson, we're here in Exhibit 12, the Greenbrier Gunderson's '302 patent, column 2, line 14.

It says: Referring now to the drawings that form a part of the disclosure herein, underframe portions of tank car 10...herein are shown in Figures 1 through 3. I skipped over some words.

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(As read:) The tank car 10 has a body bolster 12 and a side sill 14 at one end. The opposite end has a side sill 26.

Do you see that?

A. I do.

Q. All right. So the side sills are 14 and 26.

If you go to Figures 1, 2, and 3, you see items 26 and 14?

A. Yes, I do.

Q. Here they are in Figure 1, item 26 and item 14. In Figure 3, see item 26 under the tank, right?

A. I don't know. To me, in Figure 23, item 26 is pointing to the body bolster, which is not what is shown in Figure 2.

Q. Okay. Well, let's focus on Figures 1 and 2.

A. Yeah, I think Figure 3 is mistaken.

Q. Okay. So this shows a tank car with underframe side sills, right?

MR. COOPERMAN: Objection to the form of the question. Objection, calls for a legal conclusion. And objection, no

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foundation.

THE WITNESS: With this type of construction, you could really argue whether there is an underframe at all and whether those short sections connecting the body bolsters to the end sills are side sills.

They certainly serve very little structural function other than to provide mounting surfaces for the sill steps and the crossover platforms and also the vertical side handhold supports.

BY MR. LEAVELL:

Q. Well, let's -- let's go by what Mr. Saxton and Greenbrier call them in their patent.

A. Yes, and I notice they are calling them side sills.

Q. They're calling them side sills and they're saying they're part of the underframe, right?

MR. COOPERMAN: Objection to the form of the question. Objection, no foundation. And objection, calls for a legal conclusion.

THE WITNESS: Yes, right. Yes, they

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are.

BY MR. LEAVELL:

Q. Now, what Mr. Saxton and Gunderson are calling side sills, they are outside longitudinal members of the underframe, right?

MR. COOPERMAN: Objection to the form of the question. Objection, no foundation. Objection, calls for a legal conclusion.

THE WITNESS: Yes.

BY MR. LEAVELL:

Q. Those structures that Mr. Saxton and Greenbrier are referring to as side sills in Exhibit 12, are they a dedicated lengthwise running member?

MR. COOPERMAN: Objection to the form of the question. Objection, no foundation.

THE WITNESS: I guess I would say that they are.

BY MR. LEAVELL:

Q. Are the side sill 14 and side sill 26 disclosed by Mr. Saxton and Greenbrier in Exhibit 12, are they acting as the bottom chord of a side beam?

MR. COOPERMAN: Objection to the form

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of the question. Objection, no foundation. Objection, calls for a legal conclusion.

THE WITNESS: No, because a tank car does not have a side beam.

BY MR. LEAVELL:

Q. I'm going to introduce another exhibit. So if you can keep trying to refresh and see if we can fix that.

A. All right. A really nice view of your computer there, I must say.

Q. It's better than me, isn't it?

MR. LEAVELL: Are you okay, Janet, if I move it back?

THE WITNESS: I've got 11 now.

BY MR. LEAVELL:

Q. You should have 12.

A. Let me see if we do.

There it is.

Q. All right. Now let's see if you can get 13 in a minute.

A. Oh, okay.

Q. Hold on.

(Exhibit 0013 was marked for identification.)

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BY MR. LEAVELL:
Q. All right. Exhibit 13 has been introduced. If you can take a moment --
A. All right. Let me see if we can pull that up.
MR. COOPERMAN: Which exhibit? I'm sorry.
THE WITNESS: There it is.
MR. LEAVELL: 13.
THE WITNESS: Yep.
BY MR. LEAVELL:
Q. So Exhibit 13 is U.S. Patent 7,802,525 to yourself and others, right?
A. Yes.
Q. And you're the lead inventor named on this one, right?
A. Correct.
Q. And if you look at Figure 1, do you remember this patent?
A. I do. Well, we got a number of different patents on this car.
Q. Right.
A. And so -- but this one appears to be dealing primarily with the doors.

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All right. So we want to go to what figure?
Q. Figure 1.
A. Okay. Let me go back up.
Q. And if it helps, take a look at Figure 2 as well.
A. All right. Well, I'm looking at Figure 1 now.
Q. So in Figure 1, the side sill is item 22, correct?
A. Yes.
MR. COOPERMAN: Objection, no foundation.
THE WITNESS: Yes, item 22 is the side sill of the flatcar.
BY MR. LEAVELL:
Q. And item 10, which you can see in Figure 1 but maybe better in Figure 2...
A. Yeah, let me go down to that.
Yep.
Q. That's the bottom chord?
MR. COOPERMAN: Objection to the form of the question. Objection, calls for a legal conclusion. And objection, no foundation.

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THE WITNESS: You'll have to remember the -- how this car was built. In a separate superstructure, the bottom of which was item 10, was applied on top of an existing flatcar it then welded to it.
And so if we look at it purely from a stress analysis standpoint, the side sill of the flatcar, which is a bent channel section, becomes the bottom chord of the complete car structure once it is all welded together.
BY MR. LEAVELL:
Q. If you can look at column 3, line 8.
A. Where is that?
Oh, in column 3?
Q. Yes.
A. Okay. I think I've got 1 and 2 here. Oops. Oops. I hate that.
Okay. Column 3, line 8.
Q. And if you go up a little bit to line 3, it's talking about as shown in Figure 1.
Do you see that?
A. Yeah.

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Q. Figure 1 shows the completed car, right?
A. Yes.
Q. And according to line 8 of column 3, item 10 is the bottom side chords, right?
A. So, yeah, they are the bottom side chords of the superstructure.
Q. Of the side wall, right?
MR. COOPERMAN: Objection, asked and answered. Objection to the form of the question.
THE WITNESS: They are the bottom chord of the superstructure.
BY MR. LEAVELL:
Q. If you go down a little bit further on column 3 around line 60, it identifies item No. 22 as the side sill, right?
MR. COOPERMAN: Objection to the form of the question.
THE WITNESS: Yes, item 22. So they are the side sills of the flatcar.
BY MR. LEAVELL:
Q. And the --
A. But we're saying the -- but we're

saying the side sills of the modified railcar. So at this point, we're talking about the complete car with the superstructure applied to the flatcar.

Q. So item No. 10 in your '525 patent, Exhibit 13, is a lengthwise running member that acts as a bottom chord, right?

MR. COOPERMAN: Objection to the form of the question. Objection, no foundation. Objection, calls for a legal conclusion.

THE WITNESS: So if we're talking about -- again, about this car, once they are all -- once the superstructure is applied to the flatcar, the item 10 angles are no longer the bottom chord -- well -- yeah, they are no longer the bottom chord of the complete car.

The side sill of the flatcar has now become the bottom chord of the complete car. Because when we weld the sides on to the underframe, we're changing the structure of the car.

BY MR. LEAVELL:

Q. Okay. But nevertheless, when you filed this patent application, you referred to item

No. 10 as the bottom chord, right?

MR. COOPERMAN: Objection, asked and answered.

BY MR. LEAVELL:

Q. Right?

A. Apparently we did.

Q. And you referred to the underframe center sill -- or underframe side sill 22 as the side sill, right?

MR. COOPERMAN: Objection, asked and answered.

THE WITNESS: Yes, that's the terminology used.

BY MR. LEAVELL:

Q. Item 10 is not part of the underframe, right?

MR. COOPERMAN: Objection, calls for a legal conclusion. Objection to the form of the question.

THE WITNESS: Item 10 is not part of the underframe.

BY MR. LEAVELL:

Q. Item 10 is the horizontal leg of an angle, right?

MR. COOPERMAN: Objection to the form --

THE WITNESS: I --

MR. COOPERMAN: -- of the question. Objection, no foundation. Objection, calls for a legal conclusion.

THE WITNESS: I think item 10 refers to the entire angle. We have to -- I mean, in the illustrations, the arrows point to the horizontal flange of the angle, but I'm not aware of anyplace where we say that item 10 is just the horizontal leg of the bottom angle of the superstructure.

BY MR. LEAVELL:

Q. If you look at Figure 4. Do you see Figure 4?

A. I'm getting there. I'm at 7 now. Yes, I do.

Q. Item 30 is the vertical piece, vertical portion, and that you refer to as side sheet 30?

A. No. Well, it's not shown well here. And item 30 is the side sheet, but item 10 -- I mean, the way it's shown in this illustration, it appears as if somebody formed a flange on the --

on the side sheet so as to produce a very high angle section. That, in fact, is not how the superstructure was made.

The item 10 is a complete angle with a vertical leg just inboard and lapping over the inside of the bottom edge of the side sheet 30. And once welded together, you in effect have an angle, but -- a very high angle. But item 10 is, in fact, a complete angle to which the side sheet, item 30 -- to whose vertical leg the side sheet item 30 is welded.

Q. Well, there's no indication in the figures of any additional piece.

There's the vertical piece 30 and the horizontal piece 10 at least in the figures, right?

MR. COOPERMAN: Objection, asked and answered. Objection, no foundation.

THE WITNESS: Well, I'd have to look at all the other figures, but it appears that way. Let's see.

That certainly is -- yeah, I -- I would agree that the figures do not show the vertical leg of an angle -- of the angle, but

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in fact, as the cars were actually -- oh, wait, here we are. Here we are.

So we're looking at item -- Figure 5. So if you look at the left-hand side of it, you can see that there is an angle, that the bottom member of the superstructure is an angle, to which the side sheet, item 30, is welded. And you can see that the bottom of the side sheet ends several inches above the bottom heel of the angle and some distance, perhaps an inch, below the top of the vertical leg of the angle.

BY MR. LEAVELL:

Q. Okay. So if we assume item 10 is an angle --

A. Yes.

Q. -- then that is a bottom chord, as you understand the term "bottom chord," right?

A. Not --

MR. COOPERMAN: Objection to the form -- objection to the form of the question. Objection, calls for a legal conclusion.

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You can answer.

THE WITNESS: It is not the bottom chord of the complete car once -- once assembled.

BY MR. LEAVELL:

Q. And that horizontal leg of item 10 is lap welded to the rest of the deck 20, right?

MR. COOPERMAN: Objection, no foundation.

THE WITNESS: I don't know whether that is shown in the -- in the patent or not, but that is the way that the cars were constructed.

BY MR. LEAVELL:

Q. And Figure 4 shows an overlap. Obviously, it doesn't show the weld line. But one of skill in the art would understand that there would be a lap weld between the horizontal leg of 10 and the rest of the deck?

THE COURT REPORTER: I'm sorry. One of skill in the art would understand there would be?

MR. LEAVELL: A lap weld connecting the horizontal leg of item 10 to the rest of the

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deck.

MR. COOPERMAN: Objection to the form of the question. Objection, calls for a legal conclusion.

THE WITNESS: You know what? Go back and look at Figure 2.

Oh, okay. That's right. I forget. That's right. The question was whether or not there was a vertical leg to item 10.

This doesn't help that, but it does show the horizontal leg of item 10 lapping over the deck of the flatcar deck.

BY MR. LEAVELL:

Q. The flatcar deck is item No. 20 in Figure 2, right?

A. Yes. Yes.

Q. Now, as you explain it in the patent on -- let me see if I can find it.

So once you add the superstructure, you add that on top of the existing structure, right?

A. Right.

Q. And once you add the horizontal leg 10 to the existing deck 20 using a lap weld, the

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result is a greater width of the railcar, effectively creating a greater interior lateral dimension of the deck, right?

MR. COOPERMAN: Objection, no foundation. Objection to the form.

THE WITNESS: Yes, that's true.

BY MR. LEAVELL:

Q. So once you put this on there, item 10 makes the deck bigger?

MR. COOPERMAN: Objection to the form.

THE WITNESS: Yes, yes, it expands that. It, in effect, becomes part of the deck.

BY MR. LEAVELL:

Q. In Exhibit 13 on Figure 1 --

A. Okay. Hold on. Go back to it.

All right. Go ahead.

Q. Thank you.

In Figure 1 of your '525 patent, Exhibit 13, item No. 24 is the end sill, correct?

MR. COOPERMAN: Objection to the form of the question.

THE WITNESS: Yes, item 24 appears to be the end sill.

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BY MR. LEAVELL:
Q. And if you'd like to check, I can point you to the portion in the spec where it calls it the end sill, if there's any doubt.
Is there any doubt that that's the end sill?
A. No, no, not really.
Q. And just for the record, column 3, line 61 refers to end sills 24.
Those end sills 24 in Figure 1 are part of the underframe, right?
MR. COOPERMAN: Objection to the form of the question.
THE WITNESS: Yes, that's right, they're part of the original flatcar to which the superstructure is mounted.
MR. COOPERMAN: Craig, when it's a good time for a break. We've been going for well over an hour.
MR. LEAVELL: It's about an hour and twenty minutes. This is a good time for a break. Let's shoot for five, knowing it will be ten.
MR. COOPERMAN: Yes.

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THE WITNESS: So we'll return at 2:40.
MR. COOPERMAN: Approximately.
(Whereupon, a recess was had from 2:34 p.m. to 2:48 p.m.)
BY MR. LEAVELL:
Q. Mr. Dawson, I've asked you to have the '519 patent ready, but I also first want to ask you about your declaration.
Do you have that in front of you?
A. Yes.
Q. If you could turn to Page 26, please, paragraph 51.
A. Okay.
Q. In paragraph 51, you render an opinion about the definition of floor panel.
Do you see that?
A. Yes.
MR. COOPERMAN: Objection to the form of the question.
THE WITNESS: Yes, I see it.
BY MR. LEAVELL:
Q. And part of that definition of floor panel includes floor extension or extensions, right?

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MR. COOPERMAN: Objection to the form of the question.
THE WITNESS: It could.
BY MR. LEAVELL:
Q. Right. The definition says it may have one or more floor extensions, right?
MR. COOPERMAN: Objection to the form of the question.
THE WITNESS: Yes, it does.
BY MR. LEAVELL:
Q. The floor extensions that are disclosed in the NSC asserted patents, do you recall that disclosure or do I need to point that out to you again to refresh your recollection?
A. Well, I recall that the NSC patents referred to floor extensions. Without looking at the patents, I can't really comment on how they refer to them.
Q. Okay. Let's look at column 14, lines 40 to 44.
A. All right. Column 14.
Q. Are you there, sir?
A. It's taking me a while to get there.
Q. You've got the hard copy, right? You

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can use that.
A. Well, that's true. I could.
So we're looking at the '519 patent?
MR. COOPERMAN: It's Tab 1, Dick, in your materials.
THE WITNESS: Yeah, I've got it right here.
So what was it? Column 14, you say?
BY MR. LEAVELL:
Q. Yes, sir, line 40.
A. Line 40. Okay.
Q. Column 14, line 40 of the asserted NSC '519 patent says: Floor panel 44 may include floor panel extensions 140 that underlie the respective bases of stiffeners 118. Extensions 140 may be formed by trimming the floor panel stock, such that extensions 140 are integral parts of floor panel 44, rather than being joined after-the-fact as gussets welded in place.
Do you understand that that's telling you there's at least two different ways you can design the floor extensions?
MR. COOPERMAN: Objection to the form

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of the question. Objection, calls for a legal conclusion. Objection, no foundation.
THE WITNESS: Yes, yes, I do.
BY MR. LEAVELL:
Q. And if you look at Figure 4h and 4i.
A. 4h, yes.
Q. Let's look at Figure 4i, sheet 13 of 42 of the '519 patent.
Are you there?
A. I am.
Q. And you understand that the floor extension in Figure 4i is item 488, right?
A. Correct.
Q. And that would be the gusset that we just read about, right?
MR. COOPERMAN: Objection to the form of the question. Objection, calls for a legal conclusion. Objection, no foundation.
THE WITNESS: Yes, it would.
BY MR. LEAVELL:
Q. The side sheet or web is indicated in Figure 4i as items 144 and 414, right?
MR. COOPERMAN: Objection to the form of the question. Objection, no foundation.

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Objection, calls for a legal conclusion.
THE WITNESS: No, I don't think so. I think items 144 and 444 [sic] look to me to be the -- a section of the five posts. The side sheet I would interpret to be items 114, 146, 414, and 446.
BY MR. LEAVELL:
Q. Maybe I misspoke or maybe you misheard me. But I agree that 114 and 414 are the side sheet, side web?
A. Yes.
Q. Items 146 and 446 are below the floor. We're looking --
THE COURT REPORTER: Wait. I'm sorry. I'm getting all screwed up. Please start over with the last one.
MR. LEAVELL: I'll start over.
THE COURT REPORTER: Thanks.
BY MR. LEAVELL:
Q. We can agree that Figure 4i, items 114 and 414, are the side sheet and the side web, right?
A. Yeah --
MR. COOPERMAN: Objection to the form

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of the question.
Mr. Dawson, you need to pause again.
Objection to the form of the question. Objection, no foundation. Objection, calls for a legal conclusion.
THE WITNESS: Here, again, we've got some diagrams that are misleading.
So it's apparent, as I look at it, that we're looking up at the floor in this view rather than down. And so in that case, then I would agree that 114 and 414 are the side sheet.
BY MR. LEAVELL:
Q. Okay. In Figure 4i of NSC's '519 patent, the floor extension is entirely outboard of the side wall, right?
MR. COOPERMAN: Objection to the form of the question. Objection, calls for a legal conclusion. Objection, no foundation.
THE WITNESS: It's -- it's entirely outboard of the side sheet. But I would consider the side post to be part of the side wall. And the -- and the floor extensions

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are not entirely outboard of the side post.
BY MR. LEAVELL:
Q. Okay. Would you agree with me that in Figure 4i, the floor extensions are entirely outboard of the lading container?
THE COURT REPORTER: The what?
MR. LEAVELL: Lading, L-A-D-I-N-G.
THE COURT REPORTER: What was the last word?
MR. LEAVELL: Container.
MR. COOPERMAN: Objection to the form of the question. Objection, calls for a legal conclusion. Objection, no foundation.
THE WITNESS: Well, if we interpret the side sheet to be the lading container, then I would agree that the floor extensions are entirely outboard of the side -- of the lading container.
BY MR. LEAVELL:
Q. Put another way, am I correct that the floor extensions shown here in Figure 4i in the NSC patent is not going to have any lading or cargo resting on it?
MR. COOPERMAN: Objection to the form

of the question.
THE WITNESS: Not intentionally.
BY MR. LEAVELL:
Q. Meaning there could be some spillage or some crumbs that are carried along happenstance, but the idea is that the cargo is not going to be carried on the floor extensions, right?
A. That's correct.
Q. Okay. And in Figure 4i, the entirety of the floor extension is outboard of the lading container and the entirety of the extension will not be carrying any of the lading or cargo, right?
MR. COOPERMAN: Objection to the form of the question. Objection, no foundation. Objection, calls for a legal conclusion.
THE WITNESS: Yes, again, if we assume that the side posts are not considered to be part of the lading container.
BY MR. LEAVELL:
Q. Well, my question was the lading or cargo.
The lading itself is the rock or the material, right?
A. Oh, yes, yes, yes, that's true. It

would be entirely outboard of the lading.
Q. No cargo would be carried on any part of the floor extension, right?
MR. COOPERMAN: Objection to the form of the question. Objection, calls for a legal conclusion. Objection, no foundation.
THE WITNESS: Yes, yes, I would agree.
BY MR. LEAVELL:
Q. So then can we agree that whatever the meaning of floor panel or deck is, there can be part of the floor panel or deck that is not carrying the lading?
MR. COOPERMAN: Objection to the form of the question. Objection, calls for a legal conclusion. Objection, no foundation.
THE WITNESS: Yes, I would agree with that.
BY MR. LEAVELL:
Q. So in paragraph 51 of your declaration, you say, quote -- are you there, sir?
A. Yes, I'm looking at it.
Q. Page 26, are you there?
A. Yes.
Q. Paragraph 51 of your declaration, you

say: A person having ordinary skill in the art would normally understand a floor panel to be a flat, continuous surface on which lading is placed.
A. Yes.
Q. In the context of NSC's '519 patent, floor panel can include components on which lading is not placed, right?
MR. COOPERMAN: Yeah, I'm going to object to the form of the question. Objection, no foundation. Objection, calls for a legal conclusion.
And I'm asking you, I guess at this point, Mr. Leavell, what your question about what the patent means has to do with Mr. Dawson's declaration.
MR. LEAVELL: I'm trying to figure out whether Mr. Dawson understands the meaning of floor panel and deck in the context of the patent. I believe that's why we're here.
MR. COOPERMAN: No, it isn't. His declaration has nothing to do with interpreting the -- or he didn't interpret words in the patent in his declaration.

BY MR. LEAVELL:
Q. You can answer the question, sir.
MR. LEAVELL: Is there a question pending, Janet?
THE COURT REPORTER: I'll look.
MR. COOPERMAN: Let's have the question back, please.
(The reporter read the record as requested as follows:
"Q In the context of NSC's '519 patent, floor panel can include components on which lading is not placed, right?")
MR. COOPERMAN: And my objections are that that calls for a legal conclusion, that there's no foundation for that testimony, and I object to the form of the question.
THE WITNESS: So I guess my response there would be that, as I stated in paragraph 51, a person having ordinary skill in the art would normally understand a floor panel to be a flat, continuous surface on which the lading -- on which lading is placed.
He would not necessarily

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understand that to mean that the lading covers the entire surface of the floor panel. And so, therefore, he would certainly consider that portions of the floor panel might not have lading placed on them.

BY MR. LEAVELL:

Q. Is it also true, then, that a person of ordinary skill in the art would normally understand that the floor panel to be flat and continuous in part, but there could be other parts of the floor panel that are not flat and not continuous?

MR. COOPERMAN: Objection to the form of the question. Objection, calls for a legal conclusion. And objection, no foundation.

THE WITNESS: I would say that a person having ordinary skill in the art would consider that a floor panel might have vertical flanges formed at its edge for purposes of attachment to the sides.

BY MR. LEAVELL:

Q. One of skill in the art would understand that if you took a bunch of floor

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panels and lap welded them together to create the floor or the deck, that would still be a floor panel or a deck, right?

MR. COOPERMAN: Objection to the form of the question. Objection, calls for a legal conclusion.

Can you read that back, Janet, please.

THE COURT REPORTER: Sure.

(The reporter read the record as requested.)

BY MR. LEAVELL:

Q. Let me rephrase that, sir. It was a little confusing.

A person of ordinary skill in the art, they would understand that you can have multiple pieces that are lap welded together that together constitute a deck, right?

MR. COOPERMAN: Objection to the form of the question.

THE WITNESS: I think that a person having ordinary skill in the art would not expect adjacent floor panel sections to be lapped over each other as a means of joining

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them but would instead expect that the -- the adjacent edges of the separate pieces would be butt welded together thereby continuing a flat surface on top.

BY MR. LEAVELL:

Q. If there's a railcar design with multiple floor pieces, some of which are lap welded, would a person of ordinary skill in the art look at that and say, well, that's not a floor panel, that's not a deck because of the lap welding?

MR. COOPERMAN: Objection to the form of the question. Objection, calls for a legal conclusion. Objection, no foundation. Objection, asked and answered.

THE WITNESS: I have nothing further to add to my previous response.

BY MR. LEAVELL:

Q. You've used the term "deck" to refer to two pieces that are lap welded together, right?

MR. COOPERMAN: Objection to the form of the question. Objection, no foundation.

THE WITNESS: I can't think -- no such instances come to mind. I can't say that I

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never did, but I certainly don't recall having made that reference.

BY MR. LEAVELL:

Q. The statement in paragraph 51 of your declaration uses the term "floor sheet," do you see that, "floor sheet" or "abutting floor sheets"?

A. Yes.

Q. Can a floor panel or a deck be made up of pieces that are not sheets?

MR. COOPERMAN: Objection to the form of the question. Objection, calls for a legal conclusion. Objection, no foundation.

BY MR. LEAVELL:

Q. Let me rephrase. Would a person of ordinary skill in the art understand that you can make a floor panel or a deck out of pieces of material that are not sheets?

A. Yes.

Q. For example, you can have a wooden deck, right, made out of the lumber?

MR. COOPERMAN: Objection to the form of the question.

THE WITNESS: True.

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BY MR. LEAVELL:
Q. And a wooden deck made out of lumber would not include any sheets, right?
MR. COOPERMAN: Objection to the form of the question.
THE WITNESS: No, it would not.
BY MR. LEAVELL:
Q. A person of ordinary skill in the art would understand there's a lot of different types of pieces that can be used to make a deck of a gondola car, not just sheets, right?
MR. COOPERMAN: Objection to the form of the question.
THE WITNESS: Yes, he would, but he would also understand that those various other types of material -- materials used to form a deck or floor are going to be flush on the top, as is -- would be the case with the wood floor planks, for example.
BY MR. LEAVELL:
Q. And that's because, in your meaning and in your opinion, the floor sheets have to be -- or floor members have to be abutting, right?
MR. COOPERMAN: Objection to the form

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of the question.
THE WITNESS: Correct.
BY MR. LEAVELL:
Q. Okay. And when you say "abutting" in the context of at least steel floors, you mean butt weld, right?
A. In the case of flat steel flooring, yes.
Q. You say in your declaration that the word "abut," "abutting," the use of either of those words, is a clear and unmistakable reference to a butt joint in paragraph 52 of your declaration under Figure 23?
A. Yeah, I'm looking at it. And in the context of looking at floors made of flat steel sheet or plate, if they -- if the pieces are going to be butted, then it is a reference to a butt joint.
But assembling a floor out of other components, like, for example, wood planks, would entail having those elements in a -- in an abutting relationship to each other, but it would not be a butt joint, which is a specific type of weld between two flat pieces of steel.

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Q. Okay. Now, your definition or the definition that is set forth in your declaration, paragraph 51, you say: Floor panel means a floor sheet or abutting floor sheets, right?
A. Yes.
MR. COOPERMAN: Objection to the form of the question.
BY MR. LEAVELL:
Q. So when you say "abutting" there, you mean that if the floor sheets are steel, they must be butt welded, right?
A. Yes, that's right. Um --
Q. Because your use of the word "abutting" there is a clear --
MR. COOPERMAN: Mr. Leavell, I don't think he was done.
Were you finished with your answer, sir?
THE WITNESS: No, not really because, again, we're talking about a floor panel. I would not consider a floor made from wooden planks to be a floor panel.
BY MR. LEAVELL:
Q. Okay. But a bunch of wooden planks can

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be a deck, you said?
A. Correct.
Q. So in your mind, the word "floor panel" is not synonymous with "deck," is that right?
A. No, it's not.
Q. Okay.
A. It is a -- it is a subset of deck.
Q. Where you say a floor panel means a floor sheet or abutting floor sheets, when you use the word "abutting," that is a clear, unmistakable reference to a butt joint in your mind, right?
MR. COOPERMAN: Objection to the form of the question.
THE WITNESS: Yes, yes, that's right.
BY MR. LEAVELL:
Q. Because, as you just told me, if you have two metal sheets, two flat pieces of metal, that are abutting, that necessarily means, in your opinion, that it's a butt weld? That's what you say in paragraph 52, right?
MR. COOPERMAN: Objection to the form of the question.
THE WITNESS: Yes.
///

BY MR. LEAVELL:
Q. So two pieces of metal, two flat sheets of metal that are lap welded are not abutting, as you're using that term in paragraph 51, right?
A. No, they're not.
Q. Two metal pieces that are joined at a T, and I'm indicating with my hands, two metal --
A. I can't see your hand, but I understand what you're saying.
Q. Let me finish, please.
If I have two flat metal plates that are welded together in a T, that is not abutting, as you're using that term in paragraph 51 of your declaration, because that would not be a butt weld, right?
A. Let me think about that.
Yeah, I guess I would agree that that would -- they would not be considered to be abutting.
Q. When it comes to a floor sheet, how do I distinguish a floor sheet from a floor plate or a floor gusset?
MR. COOPERMAN: Objection to the form of the question.

THE WITNESS: Well, sheet and plate are sometimes used fairly casually to be virtually interchangeable, although, in fact, there is a definition established by the -- I know it's -- I guess the -- it would be the ASTM, the American Society for Testing and Materials.
The difference between sheet and plate is purely one of thickness. Below a certain level it's considered sheet. Above a certain level it's considered plate. Let me see.
What was the third element that you mentioned besides sheet and plate?
BY MR. LEAVELL:
Q. Gusset.
A. A gusset is a completely different animal. A gusset can be made of sheet or plate, but it is typically used to connect pieces together that are usually at right angles to each other and is often used as a stiffener.
Q. If I have a piece of flat steel, how do I know whether it's a sheet or a plate, as you use the term "sheet" on paragraph 51 of your

declaration?
A. Well, as I said --
MR. COOPERMAN: Objection to the form of the question.
Mr. Dawson, please pause before you answer.
THE WITNESS: Well, as I said, although the two terms are sometimes used somewhat loosely to be synonymously, to be synonymous, but the -- a strict definition is that they would vary in thickness, which would, among other things, determine the steel specification to which the steel is purchased.
BY MR. LEAVELL:
Q. When you used the term "sheet" in paragraph 51 of your declaration, were you being precise to distinguish a sheet from a plate or a thicker piece or were you using it more casually?
MR. COOPERMAN: Objection to the form of the question.
THE WITNESS: Well, flat pieces of steel used to make a floor are frequently called floor sheet even though they may be

purchased as plate, just as the flat pieces of steel used in a side assembly are commonly called side sheets, although in that case side sheets are rarely thick enough to be purchased as plate.
But, in fact, much of the flat steel flooring that I can think of is of a thickness that it would be purchased as plate --
BY MR. LEAVELL:
Q. Okay.
A. -- even though the casual reference would be to call them floor sheets.
Q. So in paragraph 51, you don't mean to exclude a floor -- a plate from falling within the meaning of floor panel, do you?
MR. COOPERMAN: Objection to the form of the question.
THE WITNESS: No, I don't.
BY MR. LEAVELL:
Q. Okay. What about the shape of a floor panel? Does a floor panel have to be rectangular or square or can it be some other shape?
MR. COOPERMAN: Objection to the form

of the question.
THE WITNESS: There is rarely any reason to use a sheet other than rectangular. But if there were for some particular car, and I can't think what that reason would be, I don't think it would disqualify it from being considered a floor sheet.
BY MR. LEAVELL:
Q. And, therefore, it would -- okay. Thank you.
What about a long, thin rectangle? Is there any reason why that shape would disqualify something from being a floor panel or a floor sheet?
A. No, no, not at all.
MR. COOPERMAN: Objection to the form of the question. Objection, calls for a legal conclusion. Objection, no foundation.
BY MR. LEAVELL:
Q. When you were forming your opinion and writing your declaration on how a person of ordinary skill in the art would understand the term "floor panel" and concluding that the use of the word "floor sheet" is consistent with how a

person of skill in the art would normally understand the term "floor panel," did you look at how the term "floor panel" was used in the asserted claims in the patent?
A. No, I didn't.
Q. I think I know the answer to this, but let me ask it anyway. I apologize. Thank you for indulging me on the time. But when you were considering in forming your opinions in paragraph 51 of your declaration about a person of ordinary skill in the art understanding that a floor panel would mean a floor sheet and so forth, had anybody explained to you the concept of claim differentiation?
A. Not that I recall.
Q. As you sit here today, do you have any understanding of what claim differentiation means?
MR. COOPERMAN: Objection, calls for a legal conclusion.
THE WITNESS: No, I don't.
BY MR. LEAVELL:
Q. When forming your opinions and writing your declaration regarding the understanding of a person of skill in the art of the term "floor

panel," did you understand one way or the other whether the specification talked about the floor panel permissively, in other words, using the word "may," we may have a plurality of floor sheets in an abutting fashion, or did that not -- was that not part of your thinking?
A. What specification are you referring to?
Q. The specification of the patents at issue, sir.
A. No, I did not.
Q. When you have two plates of steel welded together in a T, what kind of weld is that called? Is that a fillet weld?
THE COURT REPORTER: What kind of weld?
MR. LEAVELL: Fillet, F-I-L-L-E-T.
THE WITNESS: We need to make a distinction between joints and weld types.
In a T joint, it is most common to connect them with fillet welds either on one or both sides of the -- well, of the plate that ends at the connection, but that's not the only way of bringing them together.
///

BY MR. LEAVELL:
Q. If you're going to weld them, is a fillet weld the most common way of welding two plates to form a T?
A. It varies with the thickness of the plates or sheets. Fillet welds are more typically used with thinner plates or sheets.
It also depends on whether the welder has access to both sides of the plate. And if he can only make his weld on one side, then he may not be able to -- the joint may not be able to develop the full strength of the plate itself. And in that case, some sort of a groove weld would be required.
Q. As you use the term "abut" in paragraphs 51 and 52 of your declaration to mean a butt weld, am I correct that the word "abut" would exclude the contact between a hook and a circular hole?
A. I'm just not seeing any connection between a hook and a circular hole relative to a joint between two pieces of steel.
Q. In your declaration, you say that the word "abut" or "abutting" is a clear and

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unmistakable reference to a butt joint.
So, therefore, if I were to talk to you about a hook being placed into a hole, a circular hole in a sheet, and then rotated so that the hook lies flat against the sheet, that would not be an example of two things abutting, as you're using the term "abut" in your declaration, correct?
A. No, it would not.
Q. A hook and a hole like that would be inconsistent with how you're using the word "abut" or "abutting" in your declaration and in the construction of floor panel, right?
MR. COOPERMAN: Objection to the form of the question.
THE WITNESS: Yes, that would be inconsistent.
BY MR. LEAVELL:
Q. When forming your opinions and drafting your declaration regarding how a person of ordinary skill in the art would understand the term "floor panel," did you consider how the text of the NSC patents uses the word "abut"?
A. No, I did not.
Q. Paragraph 53 of your declaration on

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Page 27 on web continuity, can we talk about that for a moment? Are you there?
A. Sure.
Q. Paragraph 53 of your declaration, you say that: Shear forces are opposing forces exerted on different points of an object, thereby causing it to shear or tear apart, like ripping a piece of paper.
Is that your analogy or is that an analogy that the lawyers came up with that you adopted?
MR. COOPERMAN: Objection to the form of the question.
THE WITNESS: I believe that that analogy, yeah, that originated with the lawyers, and I considered it and took no exception to it.
BY MR. LEAVELL:
Q. Now, in a railcar design when there's shear, for example, in a web of a beam, the web and the beam are not going to tear apart, they're not going to rip apart, unless the car is poorly designed, right?
A. Well, the tendency is there to -- for

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the element -- and in this case, side sheets come to mind, to separate -- to come apart from shear. And the -- what can cause that to happen may be an overload, it may be the effect of stress concentrations as a result of fatigue, but it is certainly a -- a possibility.
Q. When we're talking about shear in the web of a beam that's carrying a vertical load, the ripping action is not from a force that's being applied on the edge of the web and tearing like you would a sheet of paper, right?
A. A force causing a -- the web of a beam to fail in shear frequently comes from weld connections. This has been a significant problem with mill gondolas having all welded sides.
Q. But there can be shear, and there is shear in a web and a beam that's vertically loaded, that will be there even if the -- the web and the beam don't fail, right?
MR. COOPERMAN: Objection to the form of the question.
BY MR. LEAVELL:
Q. In a nonfailure situation, the web will be expected to carry a significant amount of shear

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without ripping like a piece of paper, right?
A. Yes, it will.
Q. And if we're talking about the shear that's being applied to the web as a result of the normal load, that shear first goes through the upper flange, which then the flange experiences as bending, and then that force then gets transferred into the web as the vertical shear, right?
MR. COOPERMAN: Objection to the form of the question.
THE WITNESS: I'm not sure I would agree that the force first appears in -- in a flange at the upper or bottom edge and then appears in the web.
The origin of the -- let's call it the introduction of the shear load into the beam is usually going to come from some connection onto the beam. And if we're talking about side beams in a freight car, that is usually going to come from the attachment of the underframe to the sides.
BY MR. LEAVELL:
Q. The term "web continuity," in paragraph 55 of your declaration you say that it's not

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commonly used?
A. True.
Q. But you have heard of that term before your involvement in this case, right?
A. Probably.
Q. What is the purpose of having web continuity between two --
MR. COOPERMAN: Objection.
BY MR. LEAVELL:
Q. -- webs?
MR. COOPERMAN: Objection to the form of the question.
THE WITNESS: The objective of providing web continuity is to enable forces in one web to be able to be transferred to another web that is in line with it in a relatively direct manner and, thereby, avoiding stress concentrations around the connection, the interface between the two webs.
BY MR. LEAVELL:
Q. And you've got the '519 patent there, right?
A. I do.

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Q. And if you can turn to Figure 3b.
A. 3t?
Q. B as in boy, sorry, sheet 5 of 42 of the '519 patent.
A. 3b.
Oh, there it is. Okay. Yeah.
Q. In Figure 3b, do you understand what's being shown there, the cross-section?
A. Yes.
Q. You see the vertical plate labeled 146?
A. (Unintelligible.)
Q. I'm sorry. I think you said "yes," but you're away from the --
A. Oh, okay. Yes, I do see it in item 146.
Q. And item 146 is in web continuity with item 114, right?
MR. COOPERMAN: Objection to the form of the question. Objection, calls for a legal conclusion. Objection, no foundation.
THE WITNESS: Yeah, I'm assuming that items 114, 34, 36, 80, 138, and 126 are all basically the same thing presumably at different locations in the car and so -- but

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it doesn't -- which appears to be the side sheet of the car, and that does appear to be in web continuity with item 146.
BY MR. LEAVELL:
Q. And what's the purpose of having that 146 line up with item 114?
MR. COOPERMAN: Objection to the form of the question. Objection, no foundation.
THE WITNESS: Well, Figure 3b is at a crossbearer location on the car. And if we did not have item 146 there but we simply had a continuation of the crossbearer web, item 85, underneath the side sheet, then the vertical load being carried by the crossbearer and which is -- has to be transferred to the side sheet would result in all of that load going through a very small area creating a stress concentration. Item 146 spreads out the area through which the vertical load from the crossbearer is passed to the side sheet, item 146, 114, whatever.
BY MR. LEAVELL:
Q. And in that state, would item 146 be experiencing shear, tension, compression, or -- or

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some of all of the above? What would that -- what forces would be in item 146?
MR. COOPERMAN: Objection to the form of the question.
THE WITNESS: Item 146 would be subject -- would be subjected to both shear and tension. I would be hard put to think of a circumstance in which it would be subjected to any significant amount of compression.
BY MR. LEAVELL:
Q. Is it fair to say that the purpose of that plate 146 is to transmit both shear and tension forces in substantially a straight line?
MR. COOPERMAN: Objection to the form of the question. Objection, asked and answered. And objection, calls for a legal conclusion.
THE WITNESS: Yes, I'd say that's -- that would be fair.
BY MR. LEAVELL:
Q. If you can turn to paragraph 57 of your declaration, please.
A. All right.
Q. In paragraph 57, you say that: A

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person of ordinary skill in the art would not understand the ordinary meaning of the term "monolithic" to refer to a material's thickness or uniformity of thickness. And then you provide a couple of examples.

Do you see those?

A. Yes, I do.

Q. The first example is an I-beam hot rolled in a steel mill, right?

A. Yes.

Q. And the second example is butt welding two plates of different grades together, right?

A. Yes.

Q. Now, if you look at paragraph 56, the issue is the interpretation of at least half of said deck is formed from a single monolithic piece of steel sheet, right?

A. Yes.

MR. COOPERMAN: Objection to the form of the question.

BY MR. LEAVELL:

Q. An I-beam is not a single piece of steel sheet, is it?

A. Well, that's not sheet, period.

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Q. Right. So your I-beam example is not germane to a discussion about a single piece of steel sheet, right?

MR. COOPERMAN: Objection to the form of the question.

THE WITNESS: I'm not sure that I agree with that.

Yes, an I-beam has a different section and does flat steel sheet, but the concept of monolithicity, if there is such a word, could apply equally to the two of them.

BY MR. LEAVELL:

Q. If you have two steel plates butt welded together, that is not a single piece of steel sheet, is it?

A. No, no. Even though you weld them together, it has become a single piece, I guess I would say, but it's not -- but it's still comprised of two different pieces of steel, and so I would not consider it to be monolithic.

Q. Assuming the -- I'll move on.

Is the phrase "without intermediate joints" redundant of the phrase "single steel sheet"?

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MR. COOPERMAN: Objection to the form of the question. Objection, calls for a legal conclusion.

THE WITNESS: I guess you could consider it redundant.

BY MR. LEAVELL:

Q. Is there any situation you can think of where you would have intermediate joints and something could still be considered a single steel sheet?

MR. COOPERMAN: Objection to the form of the question.

THE WITNESS: No, because a joint implies the connection or joining of two separate pieces. And if we're saying that to be monolithic it has to be one piece, then as soon as we talk about two pieces joined together, then it is no longer a single piece of steel sheet.

BY MR. LEAVELL:

Q. Is the term "monolithic" a technical term in the railcar industry?

A. It's certainly not a frequently used term in the rail industry. I'm not sure what you

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mean by "a technical term."

Q. Is there a meaning for the word "monolithic" to a person of ordinary skill in the railcar industry that would be different from how somebody of skill in the art in a different industry would understand the word "monolithic"?

MR. COOPERMAN: Objection to the form of the question. Objection, no foundation.

THE WITNESS: I would say only to the extent that if the railcar engineer and the person with skill in another industry are dealing with different configurations of material, then monolithic would have to be -- the term "monolithic," I guess, would have to be adapted somewhat to the context in which it's being used.

BY MR. LEAVELL:

Q. What about the phrase "single monolithic piece of steel sheet"? Is that going to have a different meaning to different people in different industries?

MR. COOPERMAN: Objection, no foundation.

THE WITNESS: I would tend to think

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not, unless someone in a different industry has a very specific meaning or jargon, as it were, in their industry.
BY MR. LEAVELL:
Q. What about the term "directly connected"? Does that term have any specific meaning to a person with skill in the railcar industry as compared to other people?
MR. COOPERMAN: Objection, no foundation.
THE WITNESS: I would doubt it. Again, I can't speak for what -- for the terminology used in other industries, but I would expect the meaning to be essentially the same.
BY MR. LEAVELL:
Q. In your experience, is there a different meaning for the phrase differently connect -- "directly connected" as you use it in your everyday usage talking to non-railcar folks as compared to how you use it talking to railcar folks?
MR. COOPERMAN: Objection to the form of the question.
///

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BY MR. LEAVELL:
Q. I'll rephrase. Is there any difference into how you use the term "directly connected" when you're talking to non-railcar folks as compared to when you're talking to railcar folks?
MR. COOPERMAN: Objection to the form of the question.
THE WITNESS: Probably not, but then --
BY MR. LEAVELL:
Q. Do you --
A. -- I don't imagine that I use the term "directly connected" all that much with people outside the industry.
Q. Were you ever asked by counsel to consider how a person of ordinary skill in the art would understand the phrase "extending upwardly of"?
MR. COOPERMAN: I'm going to object and instruct Mr. Dawson not to answer that question because it seeks communications between Mr. Dawson as an expert and counsel.
BY MR. LEAVELL:
Q. Mr. Dawson, as part of your work on this case, did you ever spend any time thinking

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about how a person of ordinary skill in the art would understand the phrase "extending upwardly of"?
A. I believe I did.
Q. And what, if any, conclusion did you reach with respect to how a person of ordinary skill in the art would understand the phrase "extending upwardly of"?
A. I came to the conclusion that the person with ordinary skill in the art would understand that term to mean that one term -- one element or item is connected to the other and then extends upward from that joint.
Q. If I were to use the term "welded directly" with a person of ordinary skill in the art in this industry, would they understand that I would be -- what I would be referring to is welded without an intervening member or structure?
MR. COOPERMAN: Objection to the form of the question. Objection, calls for a legal conclusion.
THE WITNESS: I would say that that is the common understanding of the term.
///

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BY MR. LEAVELL:
Q. Does the term "extending upwardly of" or "extending predominantly downwardly of," are those technical terms that have a particular meaning to people of skill in the art in the railcar industry?
MR. COOPERMAN: Objection to the form of the question.
THE WITNESS: I think there's a distinction between extending upwardly or downwardly of as opposed to extending upwardly and downwardly from the other item, whatever it is.
BY MR. LEAVELL:
Q. What's the difference --
A. I think --
Q. What's the difference between "of" and "from"?
A. Well, if it's extending from, it clearly has to be connected to the other component.
If it is upwardly of it, I think there could conceivably be a -- a gap between the two or some other intervening element.

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MR. LEAVELL: Why don't we take a quick break. I might be ready to wrap up.
MR. COOPERMAN: I'm sorry. Can say that again, Craig?
MR. LEAVELL: Why don't we take a quick break. I think I might be ready to wrap up. I just want to check my notes.
MR. COOPERMAN: Okay. Ten minutes?
MR. LEAVELL: Yeah, five, ten minutes.
(Whereupon, a recess was had from 3:56 p.m. to 1:18 p.m.)
BY MR. LEAVELL:
Q. Mr. Dawson, earlier in the deposition I asked if you had an estimate of the number of hours you've worked on this matter, and I understand you've been able to find some information on that?
A. Yes, I have.
Q. What were you able to find out?
A. That I -- as of yesterday, so not including anything today, I've put 71 hours in on this case that I have billed for or will bill for.
Q. When did you first bill time on this case? When was the first day?

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A. Hold on a second.
I submitted my first bill on February 29.
Q. If I understand correctly, you've got a binder of materials with you today?
A. Actually, I've got a case full of materials and then also a binder, which has a number of different items on it.
Q. In terms of items that you looked at today during the deposition, whether it was from the box or the binder or wherever, do any of those have notes on them or are they all clean originals?
A. They were all clean originals.
Q. During the break we just had, did you talk to anybody about the substance of your testimony?
MR. COOPERMAN: Again, that's a yes-or-no question, Mr. Dawson.
THE WITNESS: Did I talk to them? Yes.
BY MR. LEAVELL:
Q. About the substance of your testimony?
A. Briefly, yes.
Q. Did you talk to them about any

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questions they may have for you after I'm done asking questions?
A. Yes. Marc indicated that they would have some --
MR. COOPERMAN: Hang on. Hang on. Hang on. Again, you're not supposed to get into the substance. That was a yes-or-no question.
THE WITNESS: All right.
BY MR. LEAVELL:
Q. So the answer is yes?
A. Yes.
Q. What did you talk about in terms of the substance of your testimony and what Mr. Cooperman was going to ask you about?
MR. COOPERMAN: So I'll instruct you, again, not to answer the question, Mr. Dawson, because it goes to the specific communications between counsel and expert. You can answer questions about when you discussed it, how long you discussed, not about what you discussed.
MR. LEAVELL: Am I correct the basis is work product assertion?

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MR. COOPERMAN: Yes.
BY MR. LEAVELL:
Q. Are you going to follow that instruction, Mr. Dawson?
A. I certainly am.
Q. Did anything that you talked about with counsel today during any of the breaks refresh your recollection about anything in this case?
A. No, I don't think so.
MR. LEAVELL: All right. I think that's all I have.
Thank you, Mr. Dawson. I really enjoyed meeting you. It's one of the funnest parts of the job, is to work with experts whether they're on our side or the other side, so thank you for your time.
THE WITNESS: All right.
EXAMINATION
BY MR. COOPERMAN:
Q. Mr. Dawson, I have a handful of questions for redirect for you, and hopefully it won't take too long to discuss.
Let's start with where we ended with Mr. Leavell's questions to you about your time

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billed in the case.
You said your first bill was about February 29th, is that right?
A. Yes.
Q. And about how many invoices have you sent so far for your work?
A. Three or four, but hold on and I'll tell you.
I've sent four.
Q. And would you say that your collaboration with counsel has been ongoing really since that earlier February -- that late February invoice?
MR. LEAVELL: Objection, lead --
THE WITNESS: Yeah, I --
MR. LEAVELL: Objection, leading, asked and answered.
BY MR. COOPERMAN:
Q. You can answer.
A. Yeah, I would say it's been basically constant. I mean, there have been periods of up to a few weeks, let's say, in which I had no involvement in the case. But it's been, I guess you could say, intermittently steady since

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February.
Q. And counsel asked you a number of questions concerning whether you formed opinions and considered some of the meanings of terms to persons of ordinary skill in the art back through October or November.
Do you remember those questions?
A. Yes.
Q. Did you, in fact, begin that consideration prior to October or November?
MR. LEAVELL: Same objections, leading, asked and answered.
BY MR. COOPERMAN:
Q. You can answer.
A. Well, of course I had many discussions with --
Q. And --
A. -- counsel before then, some of which may have --
Q. I'm going to instruct you again. I'm not asking you about discussions. I'm asking about your consideration of issues.
A. Okay. Well, I certainly considered a number of issues prior to October. At this point,

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it's kind of hard for me to say whether that consideration was specifically focused on what went into my declaration.
(Exhibit 0014 was marked for identification.)
BY MR. COOPERMAN:
Q. Okay. I'm going to try to bring up a document. I think I've got it figured out. I'm trying to introduce Exhibit No. 14.
So if you can --
A. Go back?
Q. Yeah. Tell me if you can pull that up.
A. Wait a minute. I'm looking at -- oh, okay. I was looking -- this is part of Exhibit 2, so we'll get out of that.
Let me see. Do I have an exhibit? No. Exhibit 13 is as far as I get.
Q. Okay.
MR. COOPERMAN: Mr. Leavell, do you have an Exhibit 14?
MR. LEAVELL: I do.
BY MR. COOPERMAN:
Q. Mr. Dawson, can you try to refresh again?

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A. All right.
There we are.
Q. And you see this is Defendant's The Greenbrier Companies, Inc.'s Proposed Claim Constructions. And if you go down to the bottom, you see that it's dated July 17th, 2020.
Do you see that?
A. Well, let me open it up.
Q. Sure.
A. So the date, I believe, is going to show up at the very end? Well, almost.
Well, it says Certificate of Service, July 17.
Q. And you see --
A. And it's dated July 17.
Q. Yeah, Page 2. Do you see that?
A. Yes, right.
Q. So is this an example of a document that you considered concerning patent terms prior to October of this year?
A. Yes. Yep.
Q. Okay. And counsel asked several questions, and I don't remember the exact phrasing, but it was something along the lines of

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was this a term, referring to the terms in your declaration, that you collaborated on with counsel versus one that counsel gave to you. And, again, I paraphrasing.

But do you remember a series of questions about that?

A. Yes, I do.

Q. Were there any terms or, for that matter, any paragraphs in your declaration, Exhibit 1, that counsel gave to you which you didn't consider and didn't collaborate on and didn't eventually agree to?

MR. LEAVELL: Objection to form, compound, leading, asked and answered.

BY MR. COOPERMAN:

Q. You can answer.

A. Well, I certainly agreed to everything that ended up in the final form of the declaration. And I know that I discussed the wording that was in the draft of the declaration with counsel fairly extensively.

And so the question was were there any portions that I basically accepted as written without modification? I really don't recall. If

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there were any, I would say they were not many, but I did review and eventually approve everything that went into the declaration.

Q. Okay. Thank you.

I'd like you to turn to your declaration, paragraph 35.

A. All right.

Q. And there, you talk about use of the term "chord" in the railcar industry.

A. Yes.

Q. Do you see that?

A. Yep.

Q. And you answered some questions today about certain structures on the top and bottom of webs.

Do you recall that line of questioning?

A. Yes.

Q. And your testimony mentioned terms like "top cover plate," "bottom cover plate," "top flange," and "bottom flange."

Do you recall that?

A. Yes, I do.

Q. Are top cover plates and top flanges examples of top chords?

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A. Yes.

Q. And are --

A. Yes. They're typically not used in talking about freight car sides, but they are used in conjunction with other parts of the car body's structure.

Q. And by "they," you're referring to the terms "top cover plate" and "top flange"?

A. Well, no. I was referring to -- I think -- well, I was specifically referring to -- wait. Let's go back.

Could you repeat your question, please? I'm getting myself all mixed up.

Q. Sure.

MR. COOPERMAN: Janet, would you mind reading back my question?

THE COURT REPORTER: I'll read it.

(The reporter read the record as requested as follows:

"Q And by 'they,' you're referring to the terms 'top cover plate' and 'top flange'?")

MR. LEAVELL: Objection to form.

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BY MR. COOPERMAN:

Q. Let me rephrase it.

A. Yeah, I really have to hear what went before that.

Q. Yeah. So you recall testifying about the terms "top cover plate," "bottom cover plate," "top flange," and "bottom flange," right?

A. Yes, I do.

Q. So are top cover plates and top flanges examples of top chord?

A. Yes, they can be.

Q. And bottom cover plates and bottom flanges examples of bottom chord?

A. Yes.

Q. Great.

Let's turn to Exhibit 2 to your declaration.

A. All right.

All right. Go ahead.

Q. And Exhibit 2 contains a number of graphical representations of gondola cars, is that right?

A. Yes.

MR. LEAVELL: Objection, leading.

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BY MR. COOPERMAN:
Q. Did you review each of the graphical representations and labels in Exhibit 2 to your declaration before you signed it?
A. Yes, I did.
Q. And do you believe the graphical representations and labels in Exhibit 2 are fair and accurate?
A. Yes, with the one exception that we discussed earlier with Mr. Leavell -- excuse me if I'm pronouncing your name wrong -- which was on the second page and the way that the side post gusset is shown.
And, in fact, I believe I mentioned this earlier, but it was too late to change it because it would have entailed a lot of work, but it appears to show that the side post gussets are significantly higher than the bottom flanges of the side sill. But, in fact, a closer examination of the views of the car indicate that they are, in fact, accurate representations, but they do present a -- provide, I'll call it, a misleading inference as to the position of the side post gussets.

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Q. Okay. So I want to --
A. Other than -- other than that, I think that the fairness elements of Exhibit 2 are -- are reasonable and accurate representations of the -- of the car's entail.
Q. Okay. So I want to try to be clear for the record.
Looking at Page 39 of 44 in Exhibit 2 and that inset image that points to the side post gusset.
A. Yes.
Q. Is it your testimony that that is an accurate representation of the structure, given the angle that the view is taken at?
MR. LEAVELL: Objection, asked and answered. Objection, leading.
THE WITNESS: Yes, it is accurate.
BY MR. COOPERMAN:
Q. And to the extent you commented that it was potentially misleading, I understand you to be saying that is an initial impression; but once you understand what's being shown, that impression is cleared up.
MR. LEAVELL: Objection.

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BY MR. COOPERMAN:
Q. Is that fair?
MR. LEAVELL: Objection, leading, asked and answered.
THE WITNESS: Well, I guess I would say that I now consider it to be accurate, but I still feel that many people looking at this would get the wrong -- the wrong impression in terms of how the side post gusset fits to the side sill.
BY MR. COOPERMAN:
Q. Okay. I'd like you to look at the last page of Exhibit 2. And it's Page 44 of 44. There's three images next to each other.
Do you see that?
A. Yes.
Q. And the middle image goes the side sill for the representation of the Greenbrier accused car along with the side post gusset in green.
Do you see that?
A. Yes, I do.
Q. And is that a fair and accurate representation of how the components in the Greenbrier car are put together?

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A. Yes --
MR. LEAVELL: Objection. Objection. Sorry, sorry. Objection, leading, lack of foundation.
BY MR. COOPERMAN:
Q. And, Mr. Dawson, you do need to pause and give Mr. Leavell the same courtesy you were giving me before you answer.
A. I agree.
MR. LEAVELL: Objection, leading, lack of foundation.
BY MR. COOPERMAN:
Q. And referring again to that same image on Page 44 of 44 in the middle of the page, does that image cause you the same initial concern that you had on viewing the image on Page 39 of 44 with regard to the location of the side post gusset?
A. No, I --
MR. LEAVELL: Objection, leading.
THE WITNESS: No, no, I do not have that concern.
BY MR. COOPERMAN:
Q. With regard to that particular one?
A. Right.

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MR. LEAVELL: Objection, leading.
BY MR. COOPERMAN:
Q. If you'd turn to paragraph 33 of your declaration.
A. Go ahead.
Q. Do you recall some testimony and questions from counsel regarding the images in Figure 10?
A. Yes, I do.
Q. Is the image of the I-beam in Figure 10 an accurate depiction of an I-beam?
A. It's fairly close, I guess I would say. Um --
Q. And for -- for purposes of being --
MR. LEAVELL: Let him finish.
Were you finished, Mr. Dawson?
THE WITNESS: Yeah, yeah, I'm finished at this point.
BY MR. COOPERMAN:
Q. So for purposes of being a demonstrative of basic concepts of an I-beam, is that fair and accurate?
MR. LEAVELL: Objection, leading, asked and answered.

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THE WITNESS: Yes, for those purposes it is. The cross-section is off a bit. But in terms of illustrating the relationship of the web to the top chord and bottom chord, it is reasonably accurate for that purpose.
BY MR. COOPERMAN:
Q. And are the labels "top chord web" and "bottom chord" on the I-beam in Figure 10 fair and accurate?
MR. COOPERMAN: Objection, leading, lack of foundation.
THE WITNESS: Yes, they are.
BY MR. COOPERMAN:
Q. Now, turning to the T-beam in Figure 10, is that a fair and accurate representation of a T-beam for purposes of demonstrative purposes?
MR. LEAVELL: Objection, leading, foundation.
THE WITNESS: Yes, it is.
BY MR. COOPERMAN:
Q. And are the labels "top chord" and "web" accurate for purposes of being demonstrative?

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MR. LEAVELL: Same objections.
THE WITNESS: They are.
BY MR. COOPERMAN:
Q. Let's turn to paragraph 42.
Do you recall some questions from counsel concerning the images underneath paragraph 42 at Page 22 of your declaration?
A. Yes, I do.
Q. Does Figure 16 accurately depict an example of a straight-through center sill?
A. It does.
Q. And does Figure 17 fairly and accurately depict an example of the car having a stub center sill or more than one stub center sill?
MR. LEAVELL: Objection, leading, foundation.
THE WITNESS: Yes, I would say that they are accurate representations of the difference between a through center sill and stub center sills.
BY MR. COOPERMAN:
Q. Thank you.
Turn to paragraph 52.

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A. All right.
Q. And you see there's a graphical depiction of a lap joint and a butt joint underneath para- -- I guess in the middle of paragraph 52.
Do you see that?
A. Yes, I do.
Q. And are those images in the middle of paragraph 52, in fact in Figure 23, fair and accurate depictions of a lap joint and a butt joint?
MR. LEAVELL: Objection, leading, lack of foundation.
THE WITNESS: Yes, they are.
BY MR. COOPERMAN:
Q. And then turning to paragraph -- I'm sorry. Turning to Figure 24 on Page 28.
A. All right.
Q. Tell me when you're there.
A. I'm there.
Q. Do those three images labeled "Tension," "Compression," and "Shear" fairly and accurately illustrate for demonstrative purposes tension, compression, and shearing?

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MR. LEAVELL: Objection, leading, asked and answered.
THE WITNESS: Well, the two for tension and compression certainly do. Those are fairly simple concepts.
It's difficult to illustrate shear, but I think that the way that it is shown here is a reasonable way to do that.
BY MR. COOPERMAN:
Q. Okay. And you reviewed Figure 24 and those images and considered them prior to signing your declaration, is that right?
A. Yes, I did. And I accepted them at the time.
MR. COOPERMAN: Give me one second, please.
(A pause was had in the proceedings.)
MR. COOPERMAN: All right. Mr. Dawson, thank you. That's all I have.
MR. LEAVELL: Mr. Dawson, I'm sorry, I do have a couple of follow-up questions. Hopefully Mr. Cooperman explained how this could work, but I should just be a minute.

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Okay?
THE WITNESS: All right.
FURTHER EXAMINATION
BY MR. LEAVELL:
Q. The term "chord," "flange," and "top plate" or "bottom plate," are they synonymous or are there differences?
A. There are differences. The terms top and bottom chord refer to elements at the top and bottom of a beam structure that -- that resist most of the bending stresses, tension at the bottom, compression at the top.
Flange is -- which implies a flat bar, is one possible configuration for a chord.
And I'm trying to think. What was the third term that you mentioned?
Q. Top plate, bottom plate.
A. Oh, top plate and bottom plate.
Q. And, I'm sorry, let me add to that top cover, bottom cover.
A. Okay. Well, again, top cover and bottom cover are descriptions of the top and bottom chord typically as used in underframe elements, center sills, body bolsters, and, to a lesser extent, crossbearers.
Top plate and bottom plate, again, would be -- would refer to particular types or configurations of top or bottom chords.
Q. Is every chord a flange?
A. No.
Q. Is every flange a chord?
MR. COOPERMAN: Objection to the form of the question.
THE WITNESS: Well, if we are talking about a -- elements at the top and bottom of a beam, then I would say in that case, I think every flange would be a chord.
Yeah, I'm trying to think of an instance where a flange at the top of a beam would not be considered part of the top chord.
Now, again, it may -- it may be the entire top chord. It may be part of a top -- of the top chord.
BY MR. LEAVELL:
Q. You said earlier that every chord is not a flange. Give me an example of a chord that's not a flange.

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A. Well, a tubular structure is -- are frequently used for top chords. Angles are frequently used for top chords. Even pipes are occasionally used for top chords. Channels are sometimes used for top chords.
So there are a wide variety of configurations used to function as top chords, many, I would say most, of which are not flanges.
Q. Counsel asked you about some of the graphical representations of the Greenbrier car.
Have you looked at the engineering drawings, the technical drawings of the Greenbrier car yet?
A. Yes, I believe I have. I have not spent a lot of time looking at them, but I believe that I have seen them.
Q. Do you recall the details of those drawings?
A. Well, how detailed do you mean?
I -- I would say no.
Q. As between the actual engineering drawings of the car and the graphics that were created for your declaration, which one of those should the Court rely on as the more accurate set

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of data?
MR. COOPERMAN: Objection to the form of the question.
THE WITNESS: Well, the Greenbrier engineering drawings would certainly be more accurate than the graphical representations. However, for a lay audience, the graphical representations are probably better at illustrating the -- the fundamental concepts that are being discussed.
Among other things, they exclude elements that have nothing to do with the point at issue, but which might in effect clutter the drawing, as it were, and make it more difficult for a layperson to understand -- to understand what they're seeing there.
(Exhibit 0015 was marked for identification.)
BY MR. LEAVELL:
Q. I've got a document to introduce. Hold on one second.
You're going to have to refresh, but Exhibit 15 -- I'm chuckling because Exhibit 15 to

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your deposition is also Greenbrier Exhibit 15 to its claim construction brief. So however you want to think about this, this is Exhibit 15.
And it's a printout of the metalartspress.com/books/welding-know-how.
Give it a minute. I don't know that it's loaded yet. It looks like it's still loading.
A. All right.
Were you saying that it was Exhibit 15 to my declaration? Because there's only two exhibits to that.
Q. Exhibit 15 to Greenbrier's brief.
A. Okay.
Q. It looks like it's loaded on my system. So if you can refresh it and see if you --
A. Yeah, let me...
There it is.
Q. All right. We're going to look at the last two pages of the exhibit.
A. All right.
Q. Actually, if we can just look at the last page. It looks like there's some weird page breaks in the exhibit. So if you can turn to the

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last page of Exhibit 15. Feel free to look at the whole exhibit, but I'm going to ask you about the last page.
A. All right. So I'm at the bottom of the last page. Let me get a little bit further up on the page.
So are you talking about Section II, Joint Design & Cleaning?
Q. Yes, sir. Are you there?
A. Yep.
Q. This is where the -- this is the source material for the Figure 23 in paragraph 52 in your declaration, right?
A. Yes, I believe it is.
Q. And in your declaration, you included the lap joint and the butt joint but not the scarfed joint or the butt-lap joint, right?
A. That's right.
Q. Did you make the decision to include just the lap joint and the butt joint and not the other two or did the lawyers make that decision?
MR. COOPERMAN: Objection to the form of the question.
THE WITNESS: Well, I would say the

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lawyers made that decision, but I certainly agree with them because if we look at the scarfed joint and the butt-lap joint, which, frankly, is one that I'm not at all familiar with, they -- well, the butt-lap joint in particular requires a significant degree of thickness to make it work as well as a lot of age preparation. And I don't recall I've ever seen that used in railcar construction. And I'm not so sure I've ever seen the scarfed joint either.
The third item down below there, of course, is a diagram referring to an acceptable gap -- well, actually, it says Melted Braze Filler Metal. So there's very little brazing used in railcar construction, so we can ignore that one, too.
BY MR. LEAVELL:
Q. Is a scarfed joint an example of two things that abut or are abutting?
MR. COOPERMAN: Objection to the form of the question.
THE WITNESS: I guess I would have to say that the two plates in that case, and

they would be plates and not sheets, could be considered to be abutting, but it's not a butt joint.

BY MR. LEAVELL:

Q. What about the butt-lap joint? Would those be considered abutting?

MR. COOPERMAN: Objection to the form of the question.

THE WITNESS: Yes, similarly, I would say that the two plates are abutting.

MR. LEAVELL: All right. Thank you, sir. That's all I have.

MR. COOPERMAN: I have nothing else. Thank you, Dick.

THE COURT REPORTER: Marc, do you want a rough draft?

MR. COOPERMAN: Well, I guess I want it as quickly as Craig wants it. I suspect he's going to want a final some time soon.

THE COURT REPORTER: He's going to get the final by Wednesday morning.

MR. COOPERMAN: I'll take the rough and final the same time that Craig has it.

(Whereupon, at 4:58 p.m. the deposition was concluded.)

CERTIFICATE
OF
CERTIFIED SHORTHAND REPORTER

I, JANET L. ROBBINS, a Certified Shorthand Reporter of the State of Illinois, CSR License No. 84-2207, do hereby certify:

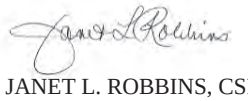
That previous to the commencement of the examination of the witness, the witness was duly sworn to testify the whole truth concerning the matters herein;

That the foregoing deposition transcript was stenographically reported by me and was thereafter reduced to typewriting under my personal direction and constitutes a true and accurate record of the testimony given and the proceedings had at the aforesaid deposition;

That the said deposition was taken before me at the time and place specified;

That I am not a relative or employee or attorney or counsel for any of the parties herein, nor a relative or employee of such attorney or counsel for any of the parties hereto, nor am I interested directly or indirectly in the outcome of this action.

IN WITNESS WHEREOF, I do set my hand and affix my seal this 7th day of December, 2020.



JANET L. ROBBINS, CSR, RPR
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December 9, 2020

To: MARC S. COOPERMAN

Case Name: National Steel Car, Limited v. The Greenbrier Companies, Inc.
Veritext Reference Number: 4357356
Witness: Richard Dawson Deposition Date: 12/3/2020

Dear Sir/Madam:

Enclosed please find a deposition transcript. Please have the witness review the transcript and note any changes or corrections on the included errata sheet, indicating the page, line number, change, and the reason for the change. Have the witness' signature notarized and forward the completed page(s) back to us at the Production address shown

above, or email to production-midwest@veritext.com.

If the errata is not returned within thirty days of your receipt of this letter, the reading and signing will be deemed waived.

Sincerely,

Production Department

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DEPOSITION REVIEW
CERTIFICATION OF WITNESS

ASSIGNMENT REFERENCE NO: 4357356
National Steel Car, Limited v. The Greenbrier Companies, Inc.
DATE OF DEPOSITION: 12/3/2020
WITNESS' NAME: Richard Dawson

In accordance with the Rules of Civil Procedure, I have read the entire transcript of my testimony or it has been read to me.

I have made no changes to the testimony as transcribed by the court reporter.

_____ _____
Date Richard Dawson

Sworn to and subscribed before me, a Notary Public in and for the State and County, the referenced witness did personally appear and acknowledge that:

They have read the transcript;
They signed the foregoing Sworn Statement; and
Their execution of this Statement is of their free act and deed.

I have affixed my name and official seal

this _____ day of_____, 20____.

_____
Notary Public

_____
Commission Expiration Date

DEPOSITION REVIEW
CERTIFICATION OF WITNESS

ASSIGNMENT REFERENCE NO: 4357356
National Steel Car, Limited v. The Greenbrier Companies, Inc.
DATE OF DEPOSITION: 12/3/2020
WITNESS' NAME: Richard Dawson

In accordance with the Rules of Civil Procedure, I have read the entire transcript of my testimony or it has been read to me.

I have listed my changes on the attached Errata Sheet, listing page and line numbers as well as the reason(s) for the change(s).

I request that these changes be entered as part of the record of my testimony.

I have executed the Errata Sheet, as well as this Certificate, and request and authorize that both be appended to the transcript of my testimony and be incorporated therein.

_____ _____
Date Richard Dawson

Sworn to and subscribed before me, a Notary Public in and for the State and County, the referenced witness did personally appear and acknowledge that:

They have read the transcript;
They have listed all of their corrections in the appended Errata Sheet;
They signed the foregoing Sworn Statement; and
Their execution of this Statement is of their free act and deed.

I have affixed my name and official seal

this _____ day of_____, 20____.

_____
Notary Public

_____
Commission Expiration Date

ERRATA SHEET
VERITEXT LEGAL SOLUTIONS MIDWEST
ASSIGNMENT NO: 4357356

PAGE/LINE(S) / CHANGE /REASON

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_____ _____
Date Richard Dawson

SUBSCRIBED AND SWORN TO BEFORE ME THIS _____ DAY OF _____, 20_____ .

_____
Notary Public

_____
Commission Expiration Date

e

Federal Rules of Civil Procedure

Rule 30

(e) Review By the Witness; Changes.

(1) Review; Statement of Changes. On request by the deponent or a party before the deposition is completed, the deponent must be allowed 30 days after being notified by the officer that the transcript or recording is available in which:

(A) to review the transcript or recording; and

(B) if there are changes in form or substance, to sign a statement listing the changes and the reasons for making them.

(2) Changes Indicated in the Officer's Certificate. The officer must note in the certificate prescribed by Rule 30(f)(1) whether a review was requested and, if so, must attach any changes the deponent makes during the 30-day period.

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VERITEXT LEGAL SOLUTIONS
COMPANY CERTIFICATE AND DISCLOSURE STATEMENT

Veritext Legal Solutions represents that the foregoing transcript is a true, correct and complete transcript of the colloquies, questions and answers as submitted by the court reporter. Veritext Legal Solutions further represents that the attached exhibits, if any, are true, correct and complete documents as submitted by the court reporter and/or attorneys in relation to this deposition and that the documents were processed in accordance with our litigation support and production standards.

Veritext Legal Solutions is committed to maintaining the confidentiality of client and witness information, in accordance with the regulations promulgated under the Health Insurance Portability and Accountability Act (HIPAA), as amended with respect to protected health information and the Gramm-Leach-Bliley Act, as amended, with respect to Personally Identifiable Information (PII). Physical transcripts and exhibits are managed under strict facility and personnel access controls. Electronic files of documents are stored in encrypted form and are transmitted in an encrypted fashion to authenticated parties who are permitted to access the material. Our data is hosted in a Tier 4 SSAE 16 certified facility.

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DEPOSITION REVIEW
CERTIFICATION OF WITNESS

ASSIGNMENT REFERENCE NO: 4357356
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12/11/2020 Richard D Dawson
Date Richard Dawson

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They have read the transcript;
They have listed all of their corrections in the appended Errata Sheet;
They signed the foregoing Sworn Statement; and
Their execution of this Statement is of their free act and deed.

I have affixed my name and official seal this 11th day of December, 2020.

Notary Public

October 15, 2024
Commission Expiration Date

OFFICIAL SEAL
LUCAS AUCHSTETTER
Notary Public, State of Illinois
My Commission Expires 10-15-2024

ERRATA SHEET

VERITEXT LEGAL SOLUTIONS MIDWEST

ASSIGNMENT NO: 4357356

PAGE/LINE(S) / CHANGE /REASON

See attached list (Attachment A)

12/11/2020
Date

Richard W Dawson
Richard Dawson

SUBSCRIBED AND SWORN TO BEFORE ME THIS 11th DAY OF December, 2020.

Notary Public

OFFICIAL SEAL
LUCAS AUCHSTETTER
Notary Public, State of Illinois
My Commission Expires 10-15-2024

October 15, 2024
Commission Expiration Date

ATTACHMENT A TO ERRATA SHEET TO TRANSCRIPT OF DECEMBER 3, 2020 DEPOSITION OF RICHARD DAWSON

Page, Line Number(s)	Original Testimony	Change	Reason
10:19-20	"The companies involved, the plaintiff, while their operations were Michigan"	"The companies involved the plaintiff, while their operations were in Michigan"	Transcription error
11:17	"I agree."	"I agree with counsel's instruction to pause."	Clarifying that the testimony was in response to counsel's instruction
30:12	"for a patent infringement"	"for patent infringement"	Transcription error
35:7	"I'd say over the past four weeks or so."	"I'd say over the past four weeks or so, but possibly earlier."	Clarifying when the figures were last seen
50:10	"I agree."	"I agree with counsel's instruction to pause."	Clarifying that the testimony was in response to counsel's instruction
51:11	"and is then attached to hot rolled channel"	"and is then attached to a hot rolled channel"	Transcription error
97:18	"That – yes, it is."	"That – yes, it is, but that's not the only time."	Clarifying when Mr. Dawson considered the meaning of the claim terms to a PHOSITA
98:10-15	"There may have been cases in which the original wording was accepted – acceptable and there was no need for further discussion about it. I can't, as I sit here today, tell you which definitions in the declaration fit in that category."	"There may have been cases in which the original wording was accepted – acceptable and there was no need for further discussion about it. I can't, as I sit here today, tell you which definitions in the declaration fit in that category. And October and November were not the only times that I considered the definitions."	Clarifying when Mr. Dawson considered the meaning of the claim terms to a PHOSITA

Richard W Dawson
12/11/2020

ATTACHMENT A TO ERRATA SHEET TO TRANSCRIPT OF DECEMBER 3, 2020 DEPOSITION OF RICHARD DAWSON

Page, Line Number(s)	Original Testimony	Change	Reason
117:22	"No."	"No, but I have seen printouts from the website."	Clarifying as to whether Mr. Dawson saw the content of the website
124:6	"which is that the flanges do solely carry the"	"which is that the flanges do not solely carry the"	Transcription error
132:12	"Yes."	"Yes, but that's not the only time."	Clarifying when Mr. Dawson considered the meaning of the claim terms to a PHOSITA
135:1	"designed it and unaware that I refer to any"	"designed it and am unaware that I refer to any"	Transcription error
142:1	"course, greater depth or heighth leads toward"	"course, greater depth or height leads toward"	Transcription error
146:3	"of the underframe in carrying butt forces"	"of the underframe in carry buff forces"	Transcription error
150:23	"it's just a grand view"	"it's just a plan view"	Transcription error
164:1	"are."	"are saying that."	Clarifying what Mr. Dawson was agreeing with
168:3	"how this car was built. In a separate"	"how this car was built. A separate"	Transcription error
183:4	"a section of the five posts"	"a section of the side posts"	Transcription error
215:9	"section and does flat steel sheet, but the"	"section than does flat steel sheet, but the"	Transcription error
235:3	"that the fairness elements of Exhibit 2 are – are"	"that in fairness the elements of Exhibit 2 are – are"	Transcription error
249:8	"age preparation"	"edge preparation"	Transcription error

Richard W Dawson
12/11/2020

The Car and Locomotive Cyclopedia

A Simmons-Boardman Publication

The Car and Locomotive Cyclopedia of American Practices

Sixth Edition

Combining the Car Builders' Cyclopedia, first published in 1879 as the "Car Builders' Dictionary," and the Locomotive Cyclopedia, first published in 1906 as the "Locomotive Dictionary," combined as the Car and Locomotive Cyclopedia in 1966.

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Automotive Vehicle Transportation

By Robert S. Hulick

Since the introduction of the multi-level autorack in the late 1950s, the railroad's share of automotive vehicle transportation has increased from less than 10% to over 70% today. This success in gaining market share was brought about by a combination of efforts from all segments of the industry. During the 1980s and early 1990s, there has been a high level of cooperation between the railroads, automotive manufacturers (customers), suppliers and the AAR, which has brought about the improved market share.

The Beginning

The first auto racks were open structures, exposing the vehicles to the weather, vandalism and debris. As the right-of-way clearances improved and concern for protecting vehicles increased, the industry started shielding the sides of the multi-level structures with protective side screening made of galvanized steel or fiberglass. It soon became clear that the increase in traffic brought with it an unacceptable level of loss and damage to the vehicles being shipped. Therefore, by the mid-1970s the industry moved to further enclose the structures with a new generation of equipment that added side panels, roofs, and partial height end doors. Though there were certain standards established at that time, there continued to be wide variations in the specifications for equipment to be built for the various service pool assignments. As the industry approached the 1980s, it also became evident that the existing system of separate car pools for each manufacturer did not provide adequate utilization of a fast growing asset base.

Improved Fleet Utilization

In 1981, the member railroads of the AAR reached a multi-level pooling agreement for the purpose of improving the distribution and increasing the utilization of the equipment. This led to the formation of the Reload project under management of the AAR. Prior to the Reload project, each manufacturer's plant had its own captured fleet of multi-level cars. The benefits of the Reload project were impressive, resulting in reduction of empty transit miles, reduced travel times, better asset utilization and improved customer service.

The beginning of the second decade of the project saw the movement toward one national pool of multi-levels to service all of the Automotive Manufacturers' finished vehicle transportation needs. One measure of the industry and the Reload project's progress since the mid-1980s is shown in the steady increase in multi-level rack loadings (See Chart A).

In 1987, a task force was established to focus on ways to manage the fleet with the primary goal to improve the productivity. The focus changed the emphasis from the saving empty mileage toward a universal Bi- and Tri-level fleet that would be usable by all automotive manufacturers.

In August 1995, management of the Reload project was transferred from the AAR to TTX Company. TTX is presently well along in the process of assuming control of not only the distribution of the multi-level fleet, but establishing uniform industry quality standards for the maintenance and certification of the multi-level fleet. This effort is coordinated with the underframe maintenance and supervision of the quality standards of the certification shops working toward a reduction in the out-of-service time for the fleet.

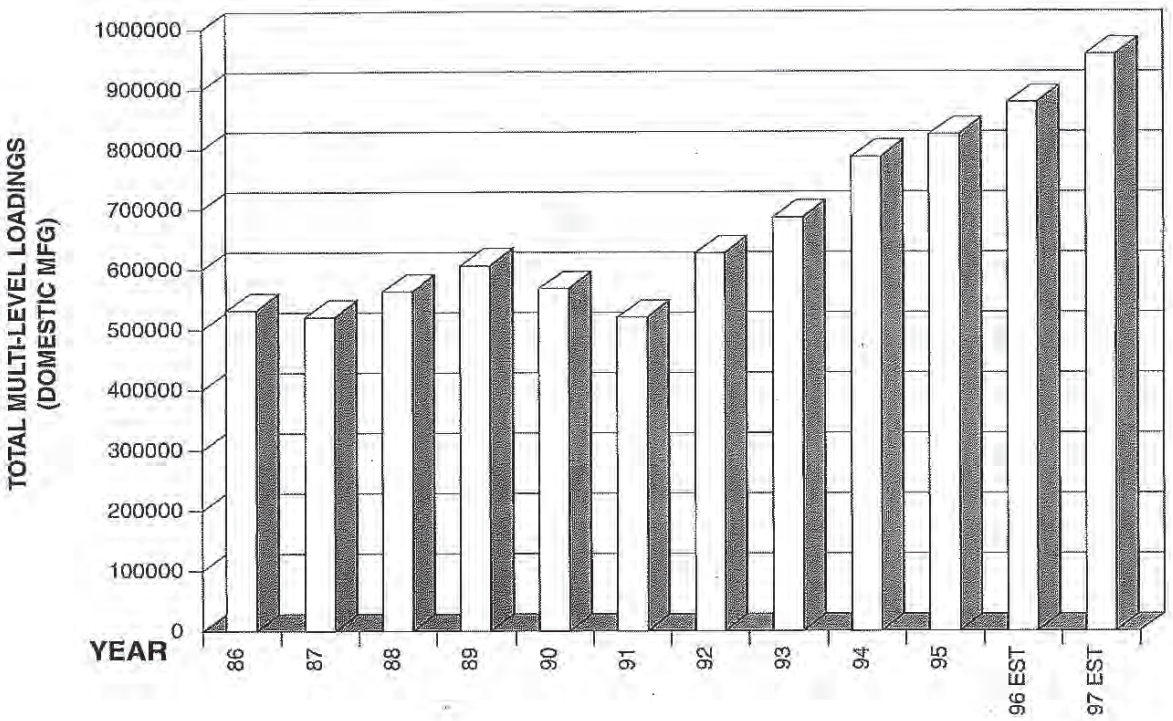
Specification Update

In 1983, the railroads and automotive manufacturers formed a multi-level railcar standardization committee, whose purpose was to develop a specification that would be the standard for the industry. The result of their efforts was the initial version of today's Universal Wide-Body Tri- and Bi-Level Fully Enclosed Autorack Car Specification (AAR-M950 and–M950A).

Upgrade of Equipment Maintenance

An important starting point in improving equipment maintenance was the "Multi-Level Certification Program" (M970), adopted in 1987. This is an ongoing maintenance upgrade program for multi-level equipment based on mileage and age, which is monitored by the Specially Equipped Freight Car Committee. They are charged with evaluating its effectiveness from the perspectives of both the railroad and their customer the automotive manufacturers.

CHART A
MULTI-LEVEL RACK LOADING



Commitment

In the summer of 1991, the following invitation was extended to railroad and automotive industry management.

The Japan Automobile Manufacturer's Association, Inc.
Invites you to attend
The Japan Automobile Manufacturer's Association, Inc.
Association of American Railroads
Executive Conference
Wednesday, October 23, 1991
10:00 a.m. to 3:00 p.m.
Conference Room: Mai-no-ma
Hotel New Otani - Tokyo, Japan

The purpose of the meeting was to:

1. Raise the awareness of senior railroad management as to issues and concerns of the automobile manufacturers.
2. Obtain the senior management commitment and involvement necessary from both sides to effectively address and resolve issues involving improvement of the quality of automobile transportation by rail in North America.

Attendance at the conference included chief executive officers from each of the major North American railroads, lead by the then Chairman of the AAR, James A. Hagen of Conrail.

In his final summary remarks, Mr. Hagen stated that "Transportation is not an afterthought but an important part of the total quality process—ending only with successful delivery of the product to the customer."

He expressed the railroad companies' commitment to the improvement of:

- Management techniques
- Equipment
- Data communications systems
- Entire way of doing business with automobile manufacturers

The railroad executives created two executive level committees to oversee implementation of this commitment and focus on the continuous improvement of the rail transportation of motor vehicles. These committees are:

- AQIEPC (Automotive Quality Improvement and Executive Policy Committee)
- AILSC (Automotive Industry Logistics Steering Committee)

These two executive committees continue to meet regularly and jointly to monitor the progress of continuous improvement.

Continuous Improvement

The movement of the automotive industry toward lighter vehicles with softer suspensions and new coating technology has resulted in many new challenges for the railroad industry. The vehicle designs are incorporating an increasing amount of lighter weight materials (plastics and composites) and electronic/computer controls that cannot tolerate the same level of intransit forces experienced by previous vehicle designs.

The automotive industry has been a leader in the continuous improvement of their product design and quality to meet the ever-increasing expectations of their customers. They in turn have looked for continuous improvement in "Total Vehicle Transportation Quality."

Areas identified requiring continuous improvement to achieve damage free transportation include:

- Vehicle door edge protection
- Ride quality and train handling
- Uniform securement to suit the vehicles of today
- Improved security
- Elimination of vehicle paint contamination
- Equipment design
- Transit reliability
- Flexibility
- Improved maintenance and service life of equipment

Various groups of railroads, suppliers, and sub-committees set out to address these issues and major improvements have been achieved:

- Specific vehicle door protection systems were approved and the majority of the multi-level fleet has been so equipped.

- TTX Company initiated an extensive development and testing program to seek improved ride quality. TTX, end-of-car cushioning suppliers and the AAR test group have developed the specifications and equipment to reduce in-train slack action with the implementation of pre-loaded end of car gears (M921D). TTX also committed to improved brake performance through the use of "stabilized" control valves. Success in identifying certain cost effective premium truck designs to address ride quality needs allowed TTX to implement an aggressive program to apply selected technology to the cars in the multi-level fleet. This program is scheduled for completion in 2000 and represents over 75% of the cars in the present fleet, the balance to be retired.

At the same time all the other improvement issues were being addressed, Thrall Car, in conjunction with their railroad customers and suppliers, was also involved with many issues concerning improving the service life of the autorack structure and its components. Examples of these include:

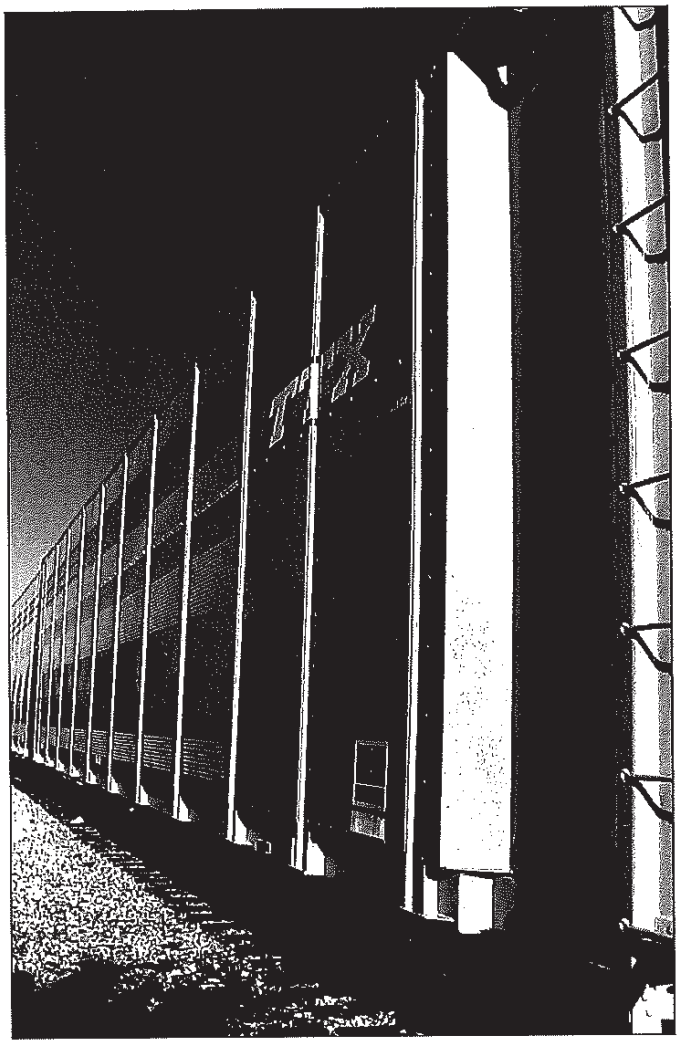
- Field service evaluated existing equipment
- Developed improved deck lift mechanism and lock for the tri-level hinged deck
- Incorporation of copper bearing steel into certain key structural elements to extend the useful service life of a rack
- Incorporation of galvanized roof rails plus increased the coating thickness on the roof sheets and side panels, to improve the service life and appearance of these components
- Changed contour of the upper deck designs to improve clearances for the light weight vehicles with softer suspensions
- Redesigned side panel securement system to provide for greater security and reduced abrasion between the metal components
- Worked in conjunction with paint manufacturers, conducting extensive tests to evaluate different paint materials and systems that would improve the corrosion resistance, weather resistance and gloss retention of the paints
- Invested in new facilities to meet the ever-increasing quality standards of the industry and the stringent environmental regulations of the EPA, including new blast facilities and 100-ft. long computer-regulated drying ovens to provide the conditions needed for the improvement of paint materials
- Incorporation of extensive pre-priming in hidden areas and caulking of joints into all areas of the autorack structure

These are just a few examples of the effort that has taken place over the last decade, but they illustrate the commitment of two industries to strive for "Total Vehicle Transportation Quality" on a continuous basis.

Equipment

While automotive equipment is not technologically an intermodal service, it has until now drawn its car supply from the same source, 89'4" standard level (41'½" floor height) and low level (31½" floor height) intermodal cars. Standard level cars are used for bi-level racks and low-level cars are used for tri-level racks. This interchangeability of car supply has allowed the railroad industry to buy enormous quantities of new trailer and container cars without obsoleting their existing 89'4" cars.

Since the 1980s approximately sixteen thousand 89'4" cars have been equipped with fully enclosed auto racks. It has only been necessary to acquire 1,500 new low-level cars during this period. Thousands of existing low-level cars received the "wide body" conversion to make them adaptable to fully enclosed auto racks. Many of these cars also received AAR Rule 88 Rebuild to enable them to operate for a 50-year life, which was necessary to allow a new rack to achieve its expected life. The standard level car supply was adequate to supply automotive demands without new car production or major modifications. While auto racks are owned by railroads, the vast proportion of cars to which they are attached are owned by TTX and control of the fleet is also man-



[Photo courtesy of Thrall Car Manufacturing Co.]

aged by TTX under the "Reload Program." A recent innovation has been to increase the height of the fully-enclosed rack from a maximum of 19' ATR to 20'2" ATR to take advantage of clearances provided for double-stack movement. These cars are equipped with tri-level racks with normal clearance on the "A" & "B" decks and additional clearance for vans on the "C" deck.

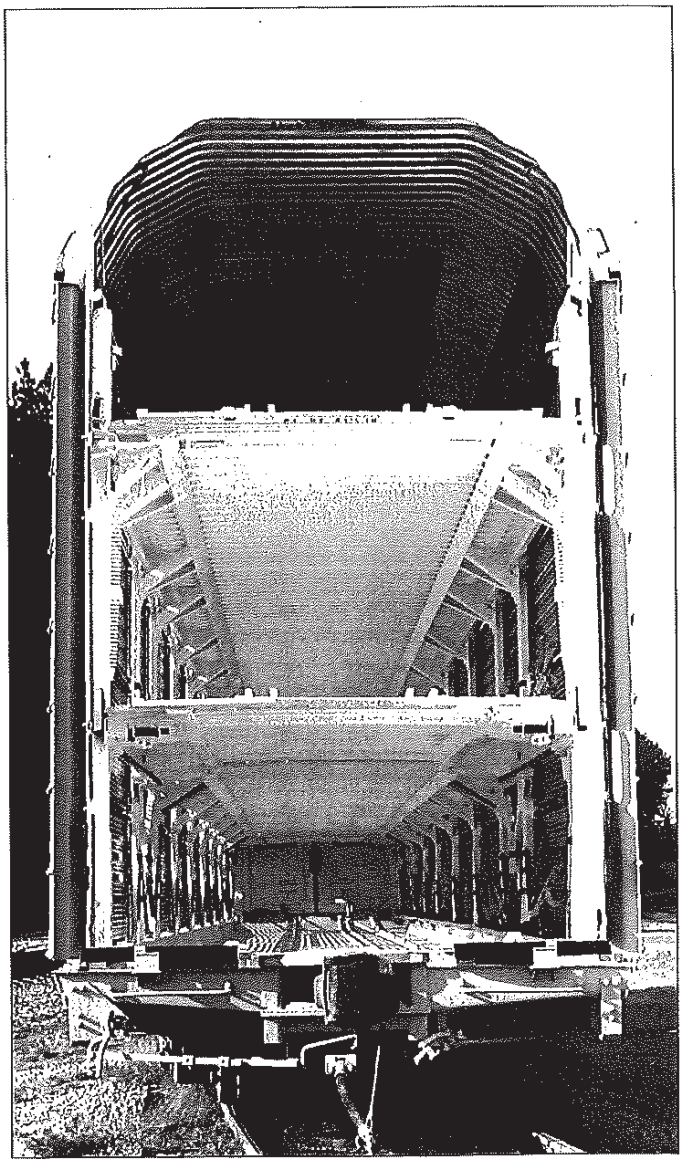
The most recent trend has been to experiment with new designs of automotive equipment in which the rack and car structure are designed as a unit rather than as an add-on. Articulation has also been used on some of these cars at least in part because of the improved ride quality of articulated cars.

The AAR Mechanical Designation for Automotive Cars is "FA" as defined in the listing found in the Section Freight Cars - Flatcars Section of the Cyclopedia. AAR Specification M-950-86 applies to fully-enclosed tri-level autorack cars and M-950A-86 applies to fully-enclosed bi-level autorack cars.

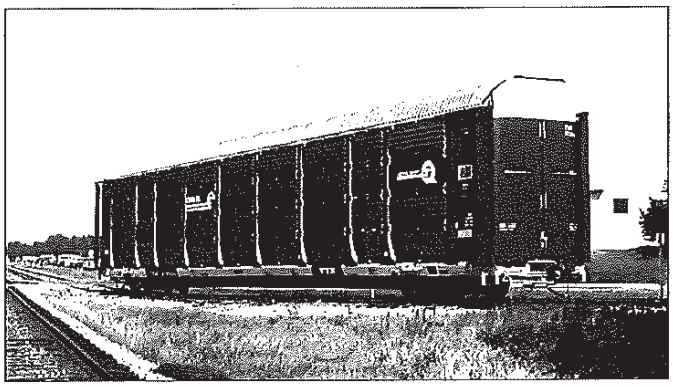
Racks

The latest model autoracks built by Thrall Car Manufacturing Company, are ready to enter service in the national multi-level pool. They are equipped with the latest Radial End door, reduced-hole side screens (6%), anti-vandalism system, and vehicle door protection.

The racks are mounted on TTX flat cars that have been upgraded to include premium trucks, preloaded end-of-car cushioning units and stabilized control valves.



End view showing racks of tri-level autorack *[Photo courtesy of Thrall Car Manufacturing Co.]*



Thrall Car Bi-Level, fully-enclosed, 90', superstructure auto rack, Model No. AB15179 *[Photo courtesy of Thrall Car Manufacturing Co.]*

Bi-Level Auto Rack

Fully enclosed, 90', bi-level superstructure and rack. Features

- Meets AAR M-950-A-92(AutoRack) specification
- Meets AAR M-941 (Radial Doors) specification
- Thrall Radial End Doors
- Galvanized roof, roof rails and side screens
- Cross-braced rack structure
- Manufactured using high-quality surface preparation, prepriming, painting and caulking systems
- High-security rack and door design

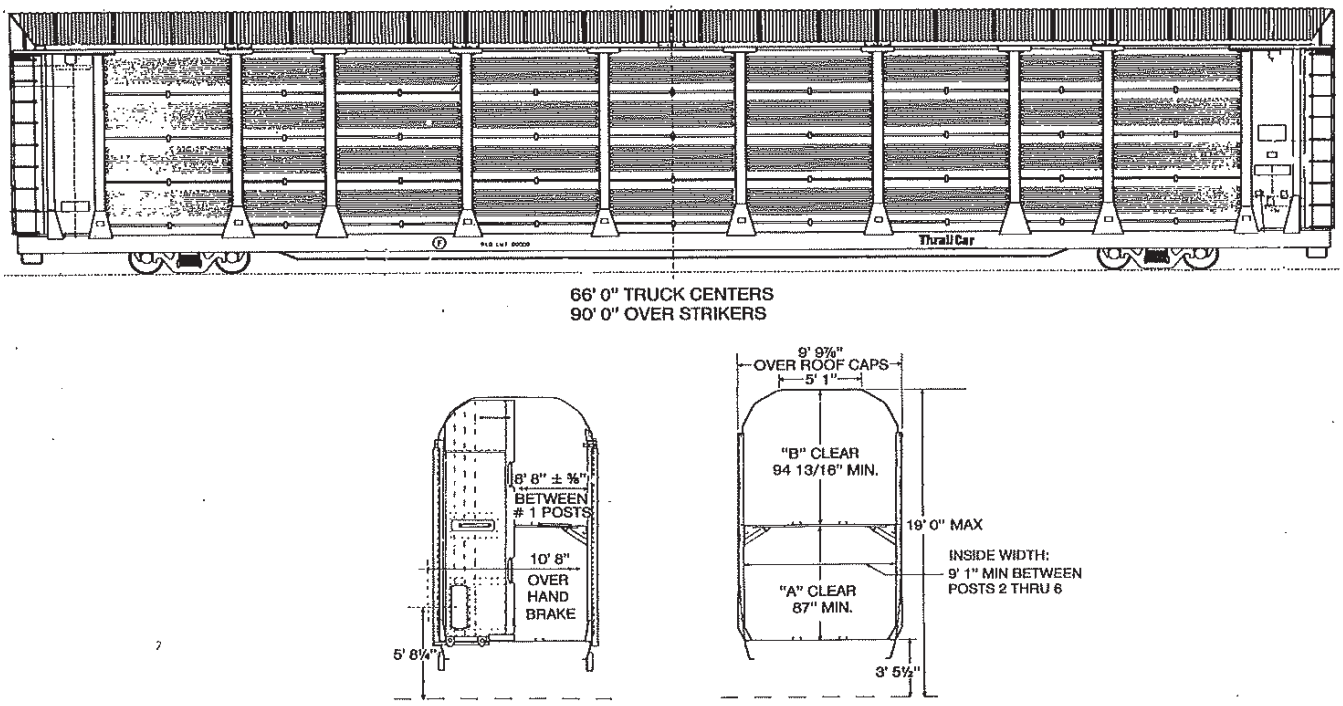
Optional Features

- Use of epoxy or other special paint systems
- Additional galvanized components
- Alternate caulk and rust prevention systems available
- Special designs to meet all customer requirements

General Dimensions

Model No. AB15179

Maximum height	19'0"
Clearance "A" deck (30" off centerline)	87"min
"B" deck (30" off centerline)	94 13/16"min
Length over truck centers	66'0"
Length over strikers	90'0"
Width over roof caps	9'9⅞"
Width between #1 posts above gussets	8'8" +/-⅜"
Width between posts #2 through #6 above gussets	9'1"min
Rail to running surface of "A" deck	3'5½" nom
Width over hand brake	10'8" max
Center line of hand brake above rail	5'8¼" nom



[Drawing courtesy of Thrall Car Manufacturing Co.]

Tri-Level Auto Rack

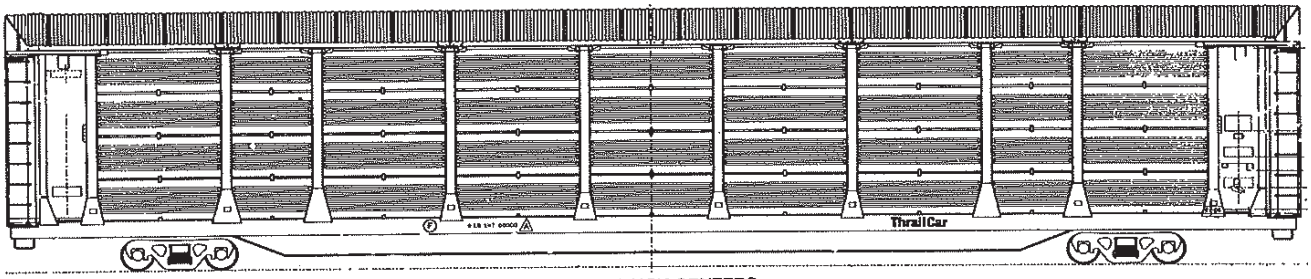
Fully enclosed, 90', tri-level superstructure and rack. Model No. AB15177 or AB15178.

Optional Features

- Use of epoxy or other special paint systems
- Additional galvanized components
- Alternate caulk and rust prevention systems available
- Special designs to meet all customer requirements

General Dimensions

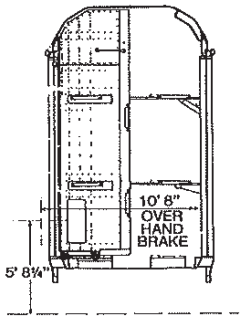
Maximum height	19'0"
Clearance "A" deck (30" off centerline)	62⅜"min
"B" deck (30" off centerline)	61⅛"min
"C" deck (30" off centerline)	65¹⁵⁄₁₆"min
Length over truck centers	64'0"
Length over strikers	90'0"
Width over roof caps	9'9⅞"
Width between #1 posts above gussets	8'4"+/-⅜"
Width between posts #2 through #6 above gussets	9'1⅜"+/-⅜"
Center line of hand brake above rail	5'8¼"nom
Width over hand brake	10'8"max
Rail to running surface of "A" deck	2'7½

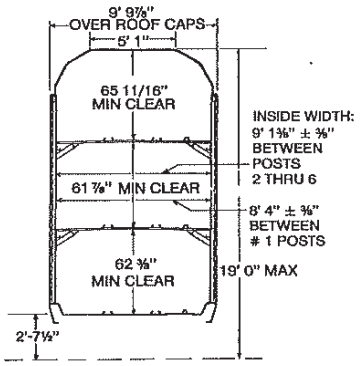


64' 0" TRUCK CENTERS
90' 0" OVER STRIKERS

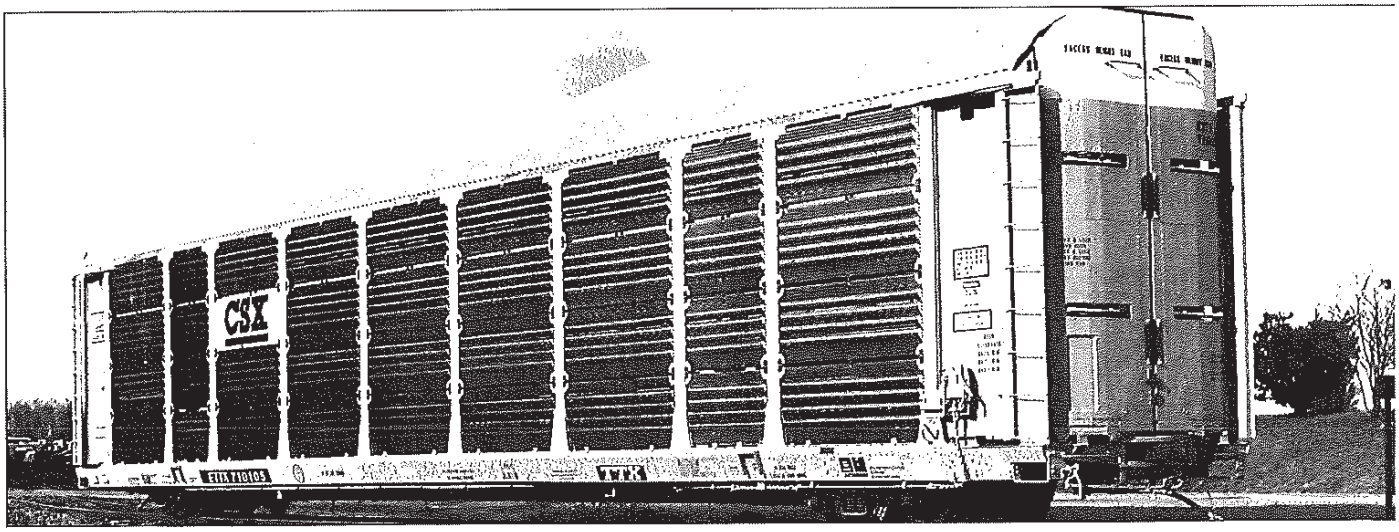
Features

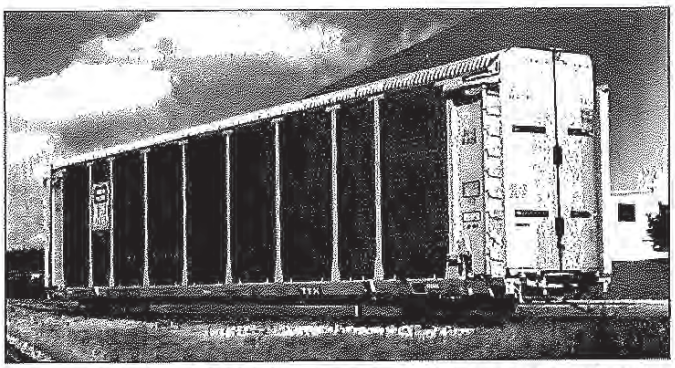
- Meets AAR M-950-92(AutoRack) specification
- Meets AAR M-941 (Radial Doors) specification
- Thrall Radial End Doors
- Galvanized roof, roof rails and side screens
- Cross-braced rack structure
- Manufactured using high-quality surface preparation, prepriming, painting and caulking systems
- High-security rack and door design





Tri-Level Auto Rack Model AB-15177/78 *[Photo and illustrations courtesy of Thrall Car Manufacturing Co.]*





Tri-level Auto Rack (20'2") *[Photo courtesy of Thrall Car Manufacturing Co.]*

Tri-Level Auto Rack (20'2")

Fully enclosed, 90', tri-level superstructure auto rack, Model No. AB-15185

Optional Features

- Use of special paint systems
- Additional galvanized components
- Thrall plastic wedge chock securement system
- Alternate caulk and rust prevention systems
- New vehicle protection systems
- Special designs to meet all customer requirements

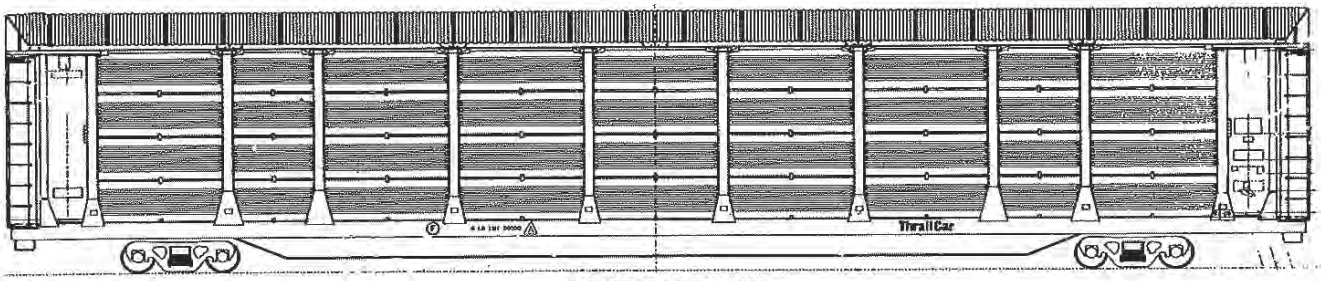
Features

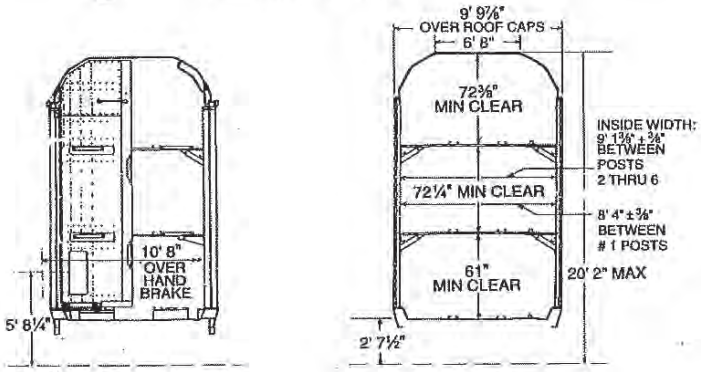
- Meets AAR M-950-92 (Auto Rack) specification
- Meets AAR M-941 (Radial Doors) specification
- Thrall Radial End Doors
- Galvanized roof, roof rails and side screens
- Cross-braced rack structure
- Manufactured using high-quality surface preparation, prepriming, painting and caulking systems
- High-security rack and door design

General Dimensions

Maximum height	20'2"
Clearance "A" deck (30" off centerline)	61" min
"B" deck (30" off centerline)	72¼" min
"C" deck (30"off centerline)	72⅛" min
Length over truck centers	66'0"
Length over strikers	90'0"
Width over roof caps	9'9⅞"
Width between #1 posts above gussets	8'4" =/- ⅜"
Width between posts #2 through #6 above gussets	9'1⅜+/-⅜"
Center line of hard brake	10'8" max
Rail to running surface of "A" deck	2'7½"

Tri-Level Auto Rack (20' 2")

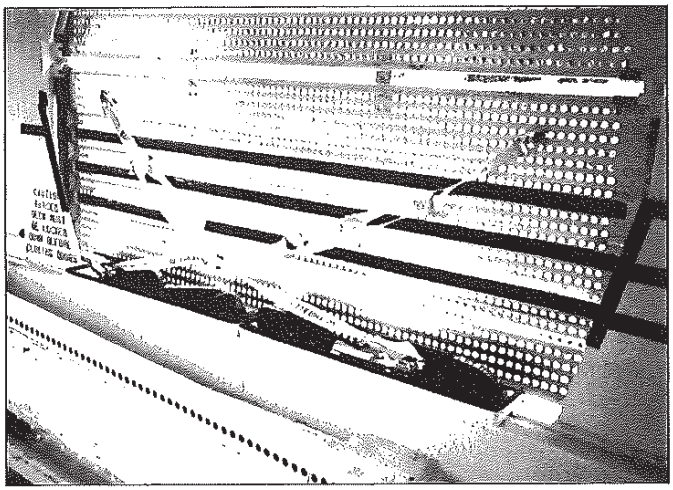




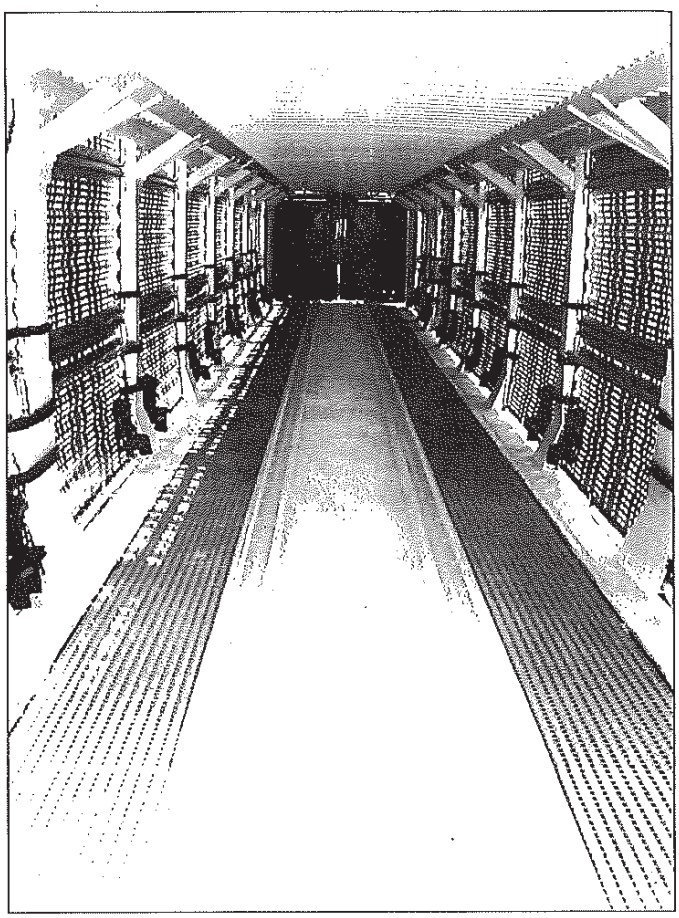
Vehicle Securement

The universal tri-level fleet is currently equipped with a third rail system developed by Thrall Car. Shown is a vehicle set of the Thrall Car polymer chock system with single strap and low profile ratchets.

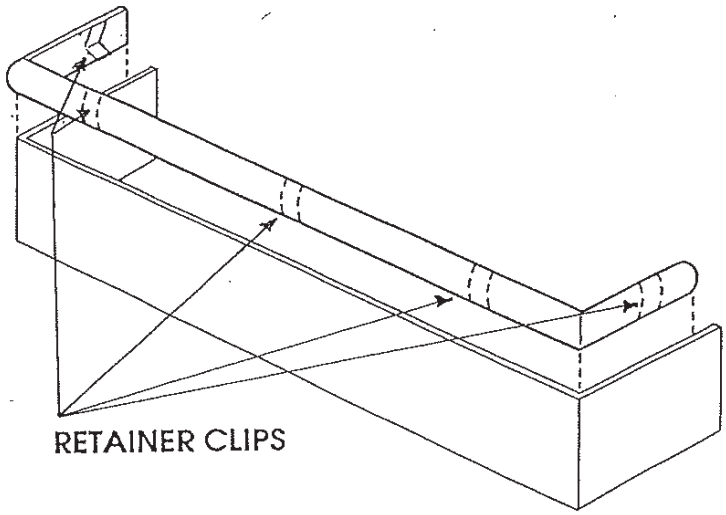
The universal bi-level fleet is also currently equipped with the Holden Grate/Lock System.



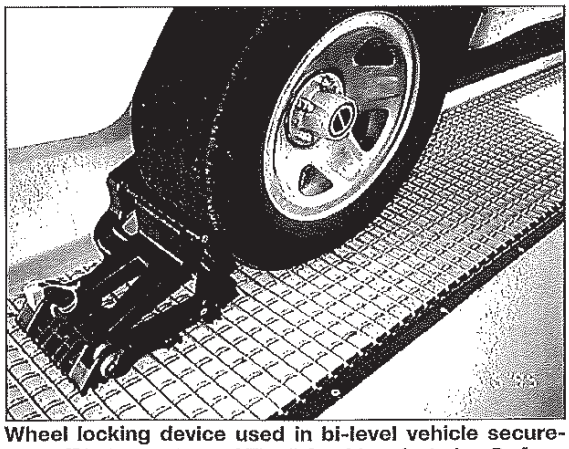
Tri-level Vehicle Securement. The Thrall Car Plastic Wedge Chock System. *[Photo courtesy of Thrall Car Manufacturing Co.]*



Bi-level Vehicle Securement *[Photo courtesy of Thrall Car Manufacturing Co.]*



ZefTek™Chock Box Protector *[Drawing courtesy of ZefTek, Inc.]*



Wheel locking device used in bi-level vehicle securement *[Photo courtesy of Thrall Car Manufacturing Co.]*

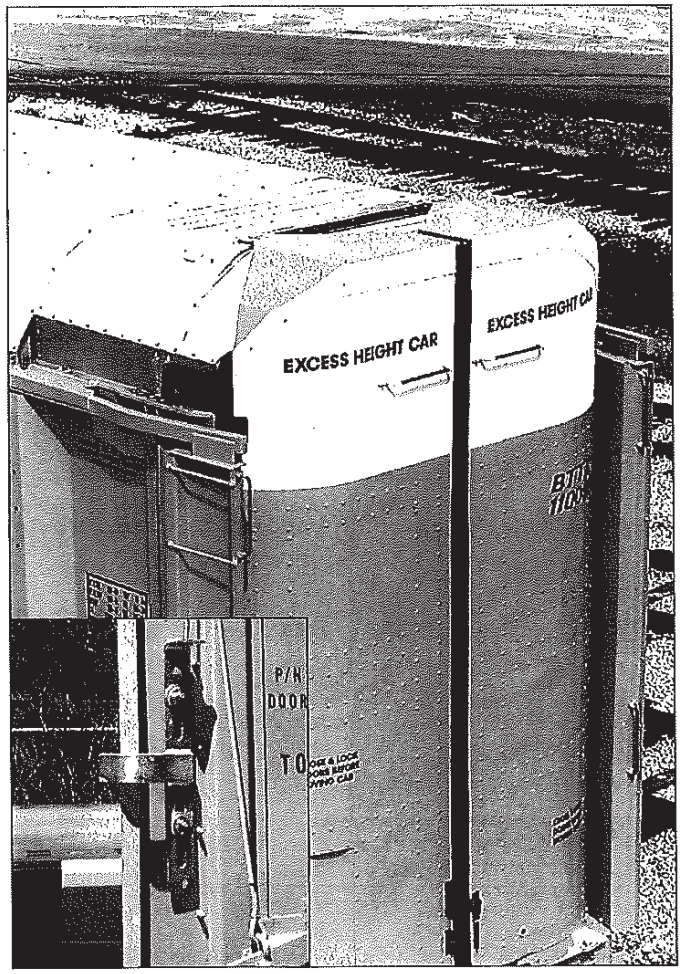
End Doors

Thrall Car and Prime Composites have developed and installed the first composite end doors on a standard bi-level auto rack. It is expected that refinements found in the service evaluation will further reduce the initial 30% weight savings.

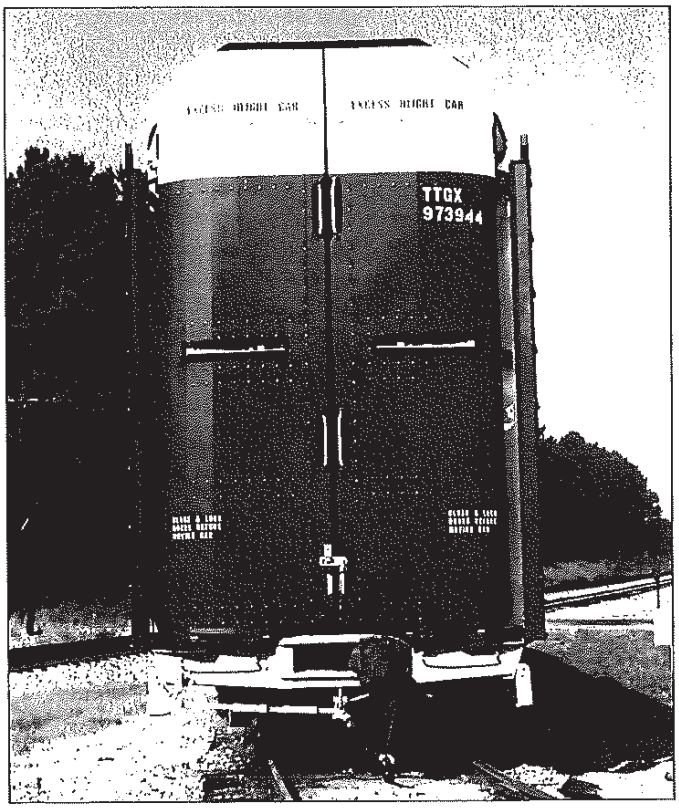
The Thrall Car Radial End Door complying with AAR M941 specifications has seen ongoing incremental improvements since it was first introduced in 1975 by the Whitehead and Kales Company.

The Thrall Car SealSafe Radial Door provides greater security and reduced openings to minimize entry of rail dust that could contaminate vehicle paint finishes. The roof pivot arm improves stability of the door intransit, eliminating several points of potential wear thereby reducing maintenance. The SealSafe door also provides the necessary security to keep "riders" from breaking into the Universal Car.

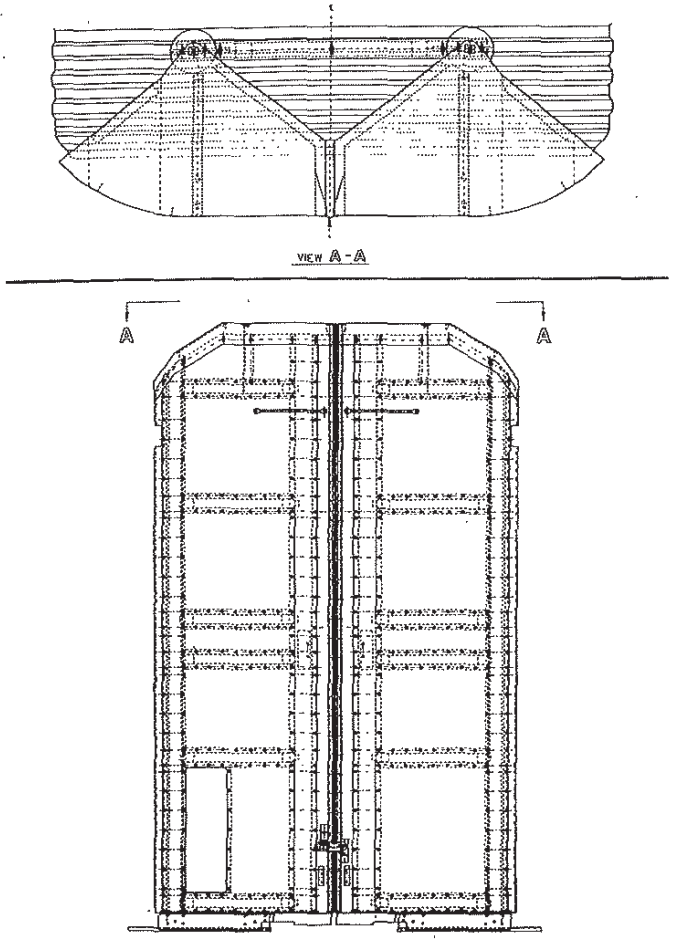
NyRail™ LTX Door Roller by Thrall Car Manufacturing Co.



Thrall Car's new SealSafe Radial Door™. Thrall Car's security lock for Radial Doors prevents unlawful entry with hasp and seal intact. *[Photo courtesy of Thrall Car Manufacturing Co.]*



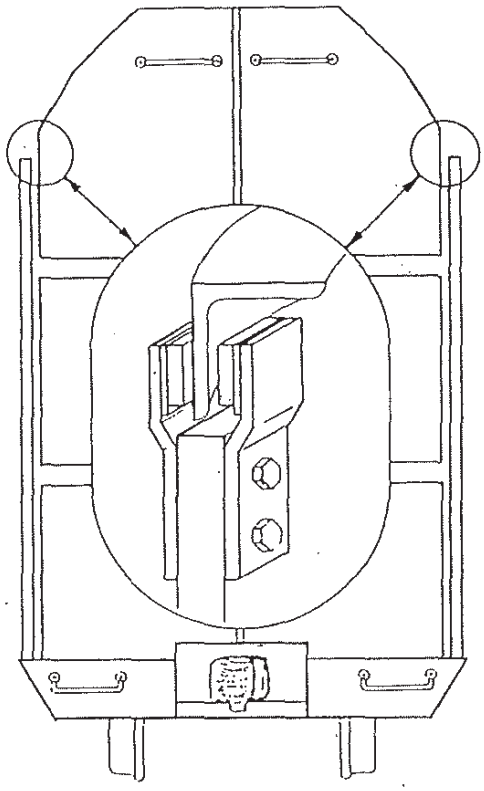
Thrall Car Radial End Door *[Photos courtesy of Thrall Car Manufacturing Co.]*



SealSafe Radial Door™ *[Drawing courtesy of Thrall Car Manufacturing Co.]*

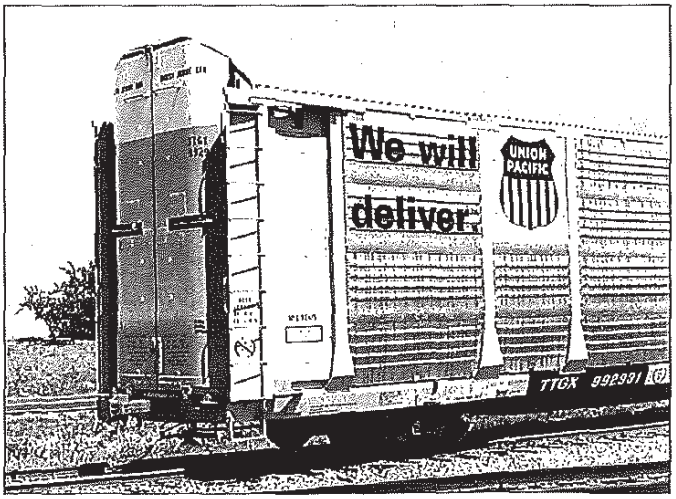
Thrall Car's popular Radial Door underwent a top to bottom redesign. Each door now features far fewer and much smaller openings, along with ergonomically designed safety features. Strongly supported at the top and bottom, doors remain stable, lowering maintenance substantially.

- Hinge plate control secures doors at the top and bottom
- Handholds boost safety, comfort and access
- Gaps and openings reduced by 91% from 6.2% of door area to 0.54%, eliminating the entry of contaminants at the most critical point
- Door slots at bridge kits removed, eliminating contaminant entry at that point
- Gasketed closure at nose of door and flexible closure at back of door to keep contaminants out
- Doors free of any high maintenance finger guide wear points
- Hinge point support at the roof greatly increases security by eliminating pry points



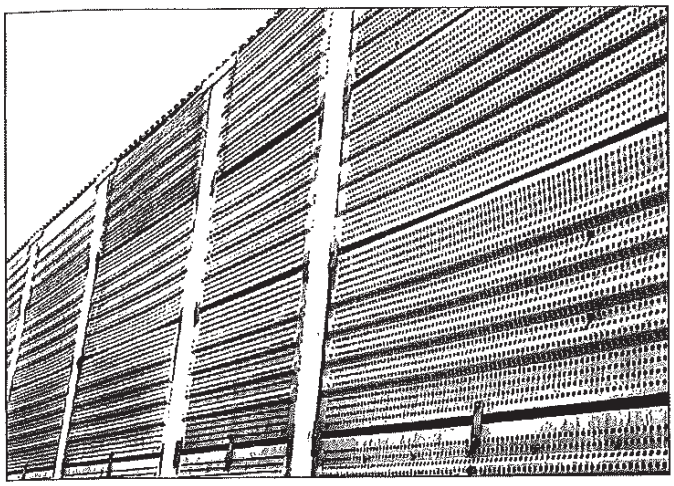
Autorack Door Protector (Top Door Guide) *[Drawing courtesy of ZefTek, Inc.]*

The Autorack Door Protector maintains clearance between the top door guides and the top door track, to eliminate wear and extend service life of top door guides and track. It also reduces vibrations and stresses on other door components occurring when standard steel parts wear.

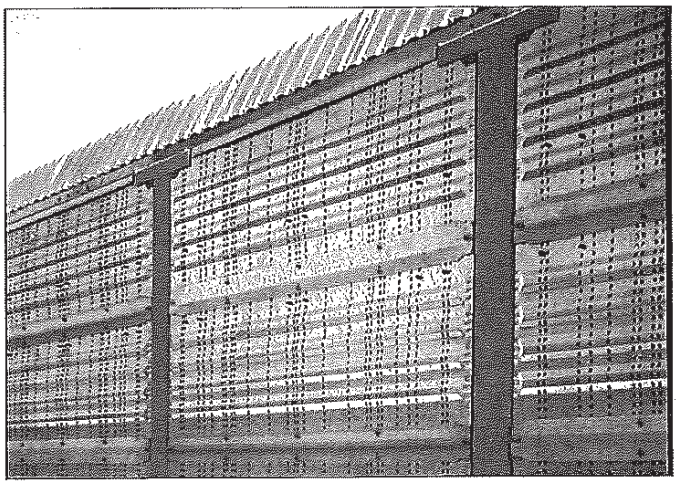


Bi-Level auto rack with composite end doors *[Photo courtesy of Thrall Car Manufacturing Co.]*

Security and Dust Contamination



Older multi-level with 18% opening in side panel area with minimum security. *[Photo courtesy of Thrall Car Manufacturing Co.]*

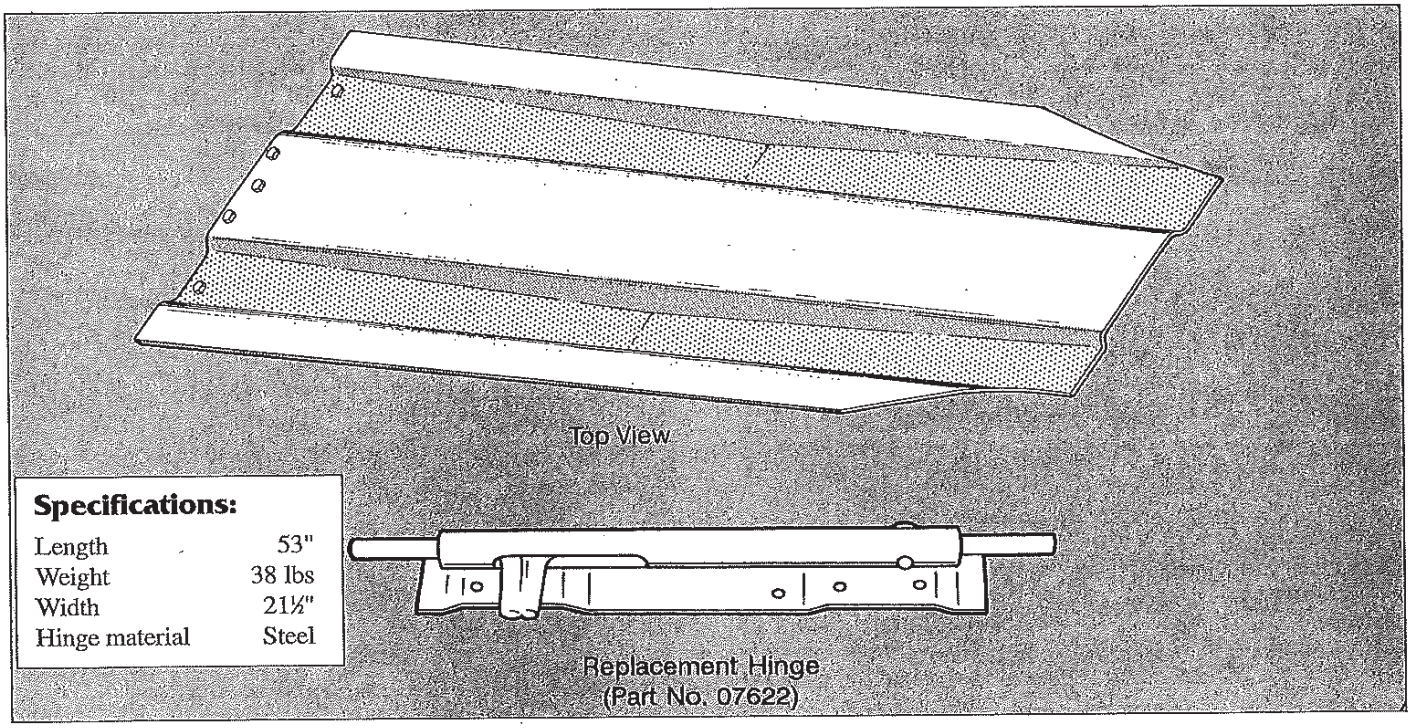


Side screen security system installed on bi-levels in May 1997. New and rebuilt multi-levels are being equipped with reduced hole side panels and an anti-vandalism system *[Photo courtesy of Thrall Car Manufacturing Co.]*

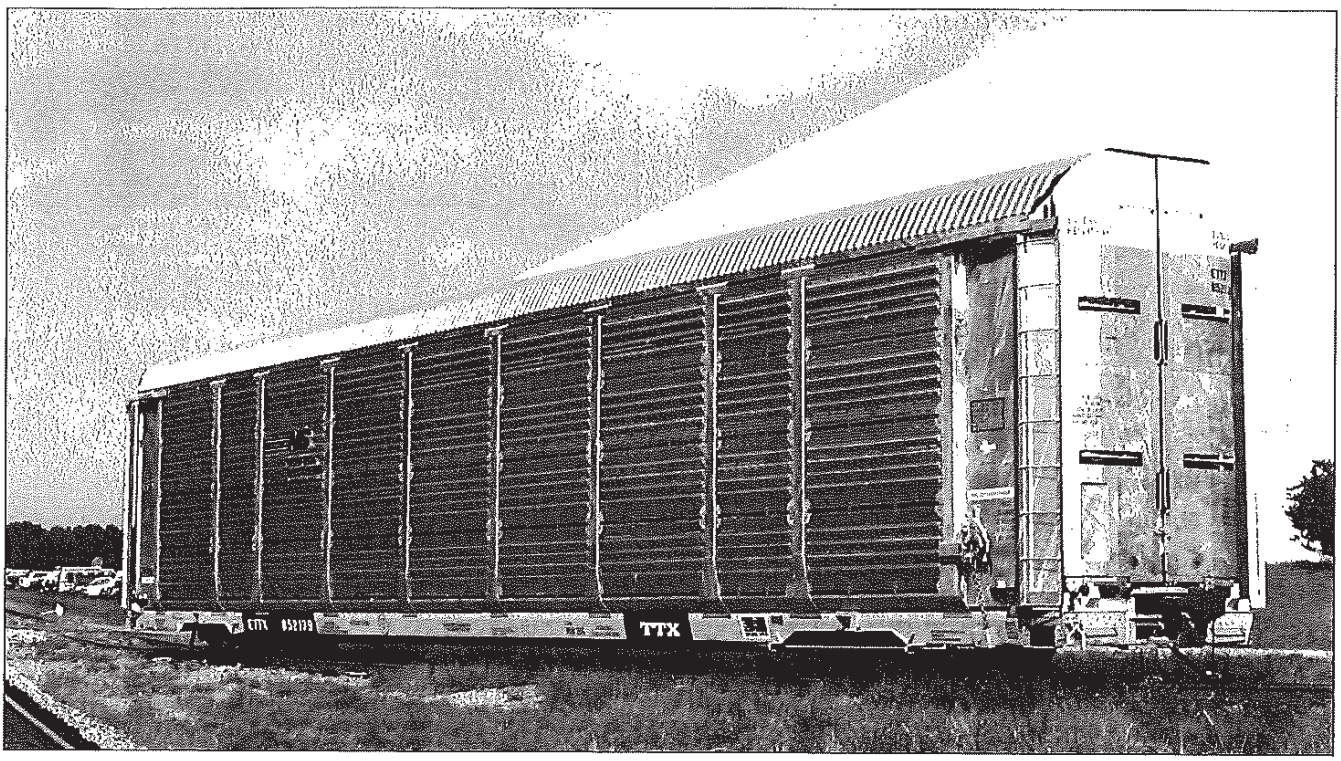
The AAR standard screen hole pattern underwent a change in 1995 in order to reduce the overall side openings to 4 to 6 percent of the overall area. In May 1997, the newest screen systems were being installed on bi-levels.This has greatly reduced the entry of contaminants during shipment and has resulted in the delivery of cleaner vehicles at destination.

In addition, anti-vandalism barrier plates are applied to gaps between screens to reduce contaminant entry and also increased the security of the side configuration of the autorack design. With the most recent developments, the side-screen package is capable of 1000-pound pull tests at any point in the system.

Bridge Plates



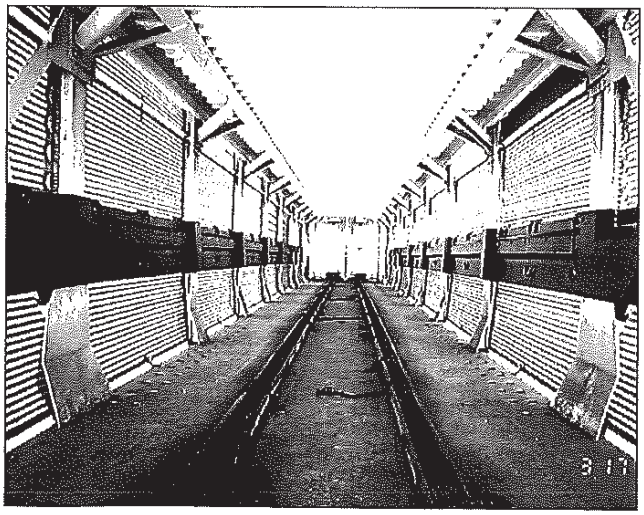
Bridge plate for Auto Rack Cars *[Photo courtesy of Stanrail Corporation]*



Thrall Car working with Norfolk Southern produced a "Galvanized Tri-Level" *[Photo courtesy of Thrall Car Manufacturing Co.]*

Testing of Protective Coatings

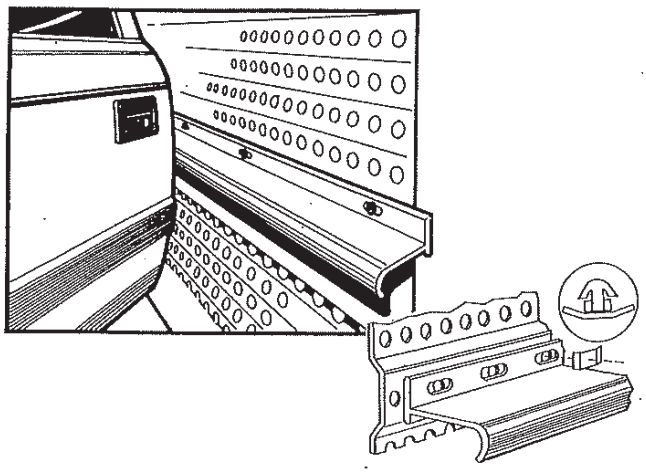
In the search for an improved coating to extend the multi-level service life against corrosion, Thrall Car, working with Norfolk Southern, produced a "Galvanized Tri-Level." In addition to the normal coatings found on the roof and side panels; the end doors, entire side structure and side ladders were also coated with galvanizing.



Thrall Car's Door Edge Protection System *[Photo courtesy of Thrall Car Manufacturing Co.]*

Vehicle Door Protection

To avoid door damage during the loading and unloading process, door edge protection systems have been developed for both bi-level and tri-level equipment.



ZefTek EdgeGard™ Left Door Protection System *[Photo courtesy of ZefTek, Inc.]*

New Technology

Vehicle Transport

One of the sub-committees formed by "AQIEPC" was the Future Distribution Systems Task Force (FDSTF). Their purpose was to focus on the elements of the next generation of equipment for the rail transportation of automotive vehicles. Several of the concepts have been progressed through the development of prototypes, public and service tests and some have been placed in scheduled service. Three concepts currently under review are:

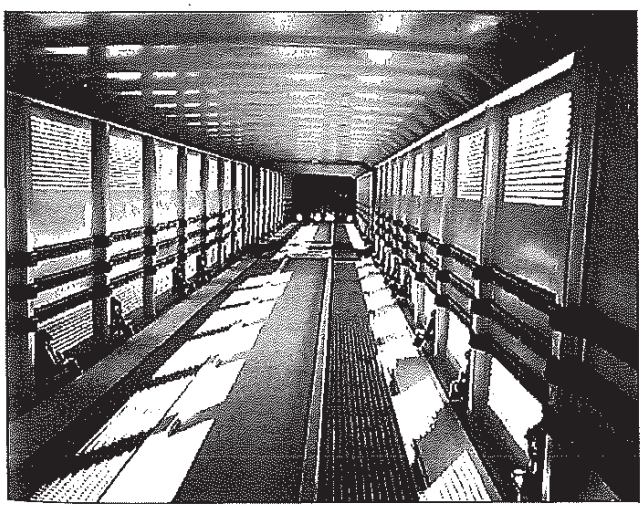
1. The ABL (articulated bi-level by Thrall Car Mfg Co.)
2. Autostack®-System
3. AutoRailer™ / AllRailer™

Thrall's ABL

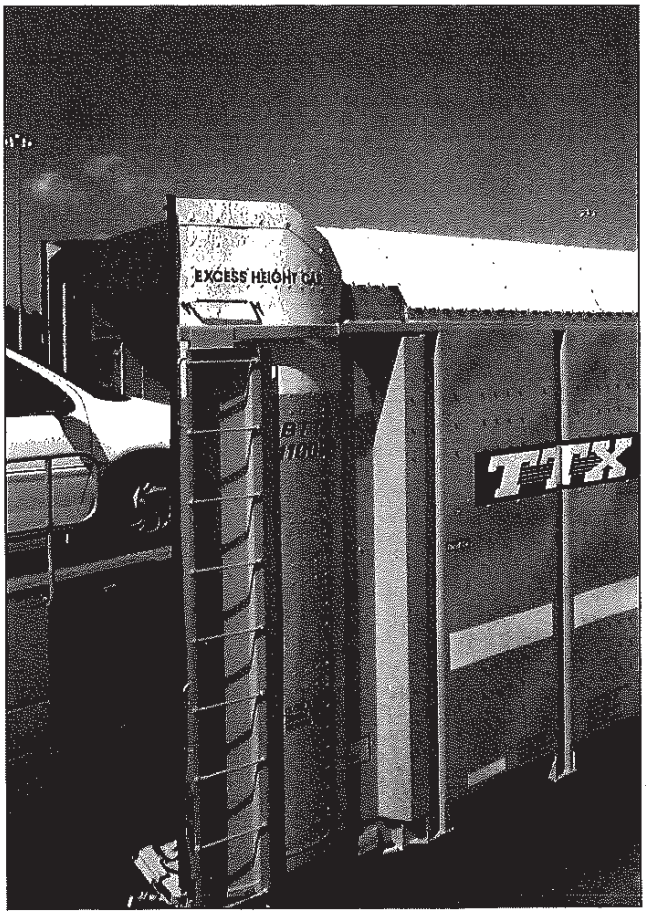
Thrall Car, in partnership with TTX Company, has produced their "ABL car, an articulated bi-level," which has passed all structural and trackworthiness certification tests required by the industry for new car designs.

It features:

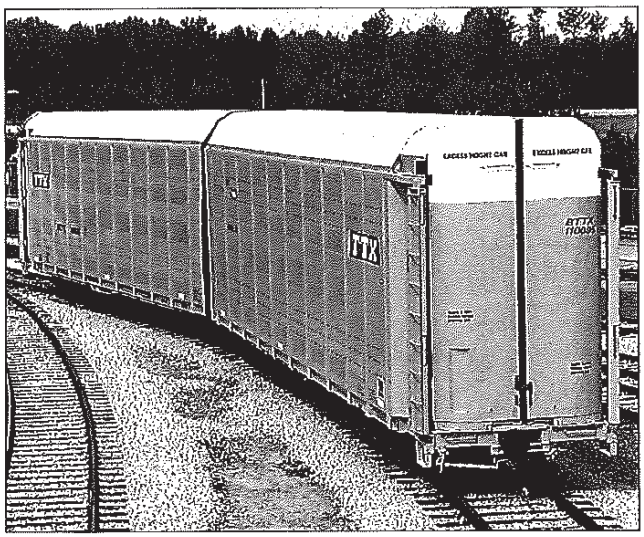
- The wide, clean bore design which eliminates obstructions, offering easy movement around vehicles, and reduction of possible damage
- Clustered openings in the side structure that dramatically reduces the ability of contaminants to enter the car, in a cost effective passive manner
- Compatibility with existing bi-level fleet
- Unique pivot platform system providing for highly efficient loading patterns (Vehicles can be transported while loaded across the articulation joint).
- Maintenance-free, passive light and ventilation system
- Only 6% of side surface area is open (versus 18% for most auto racks), and only 0.154% of the car's ends are open (versus 6.2% for racks), dramatically reducing the ability of contaminants to enter the car
- White, plastic-coated, rust-free roof reflects heat, keeps interiors cooler
- Loads over articulation for highly efficient loading patterns and fully-compatible with current bi-level system
- Capable of loading any automobile, sport utility vehicle, light truck or van
- Impact-absorbing, foam "Door Edge Protection" system forms a ring of protection around automobiles
- Boxcar-like sides and the SealSafe Radial Door™ to prevent unlawful access with fewer and smaller openings, hinge plate control to secure doors at the top and bottom, and hinge point support at the roof to greatly increase security by eliminating pry points



Interior of the wide clean-bore ABL car *[Photo courtesy of Thrall Car Manufacturing Co.]*



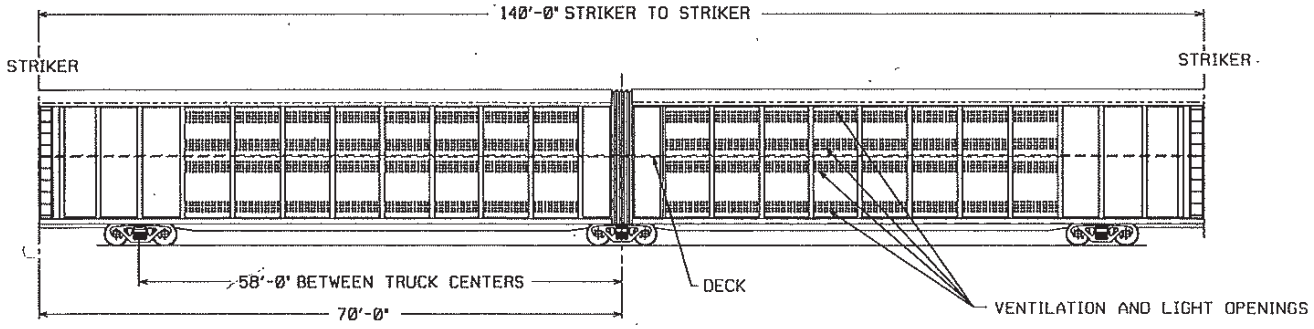
Vehicle being loaded into Thrall's articulated bi-level at a loading ramp in Lawrenceville, Georgia *[Photo courtesy of Thrall Car Manufacturing Co.]*

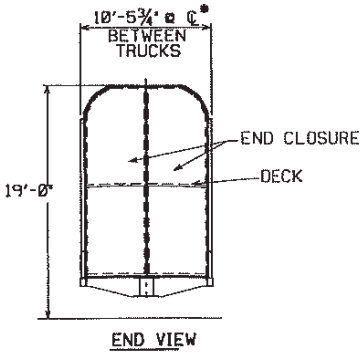


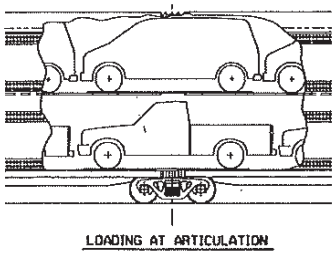
The ABL car designed and built by Thrall Car in partnership with TTX Company. *[Photo courtesy of Thrall Car Manufacturing Co.]*

Dimensions

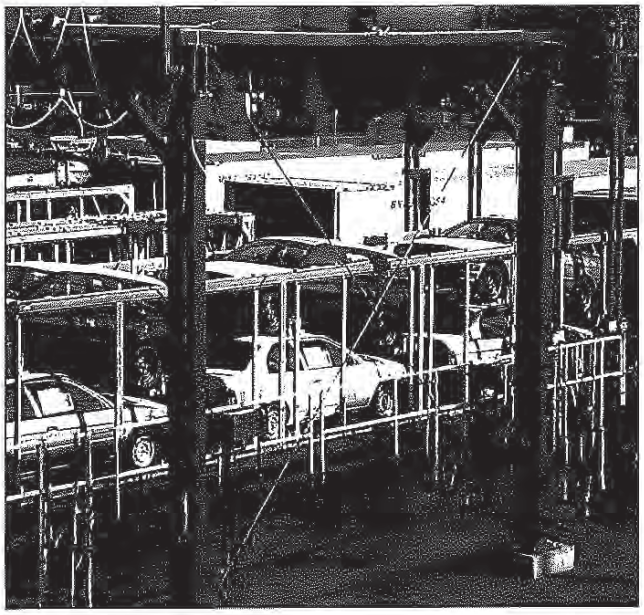
Length over strikers	140'0"
Extreme heights	19'0" max
Extreme width (at mid-point between truck centers)	10'5¾"
Car floor height (ATR)	3'3½"
"B" deck height at running surface	10'10½"
"A" deck clear height at articulation	87½"
"A" deck clear height at entry	87½"
"A" deck clear height at remainder of interior	88¼"
"B" deck clear height at articulation	91⅛"
"B" deck clear height at entry	94⅛"
"B" deck clear height at remainder of interior	95⅝"
Inside width at interior posts	9'10¾"
Inside width (between posts)	10'5¼"
Inside width at articulation (flexible closure)	9'6"
Inside width at "A" deck floor	9'10¾"

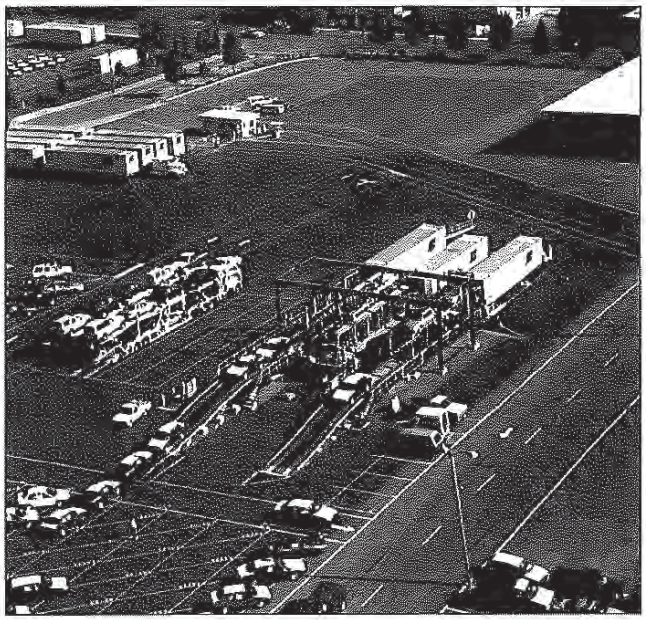






[Drawing courtesy of Thrall Car Manufacturing Co.]



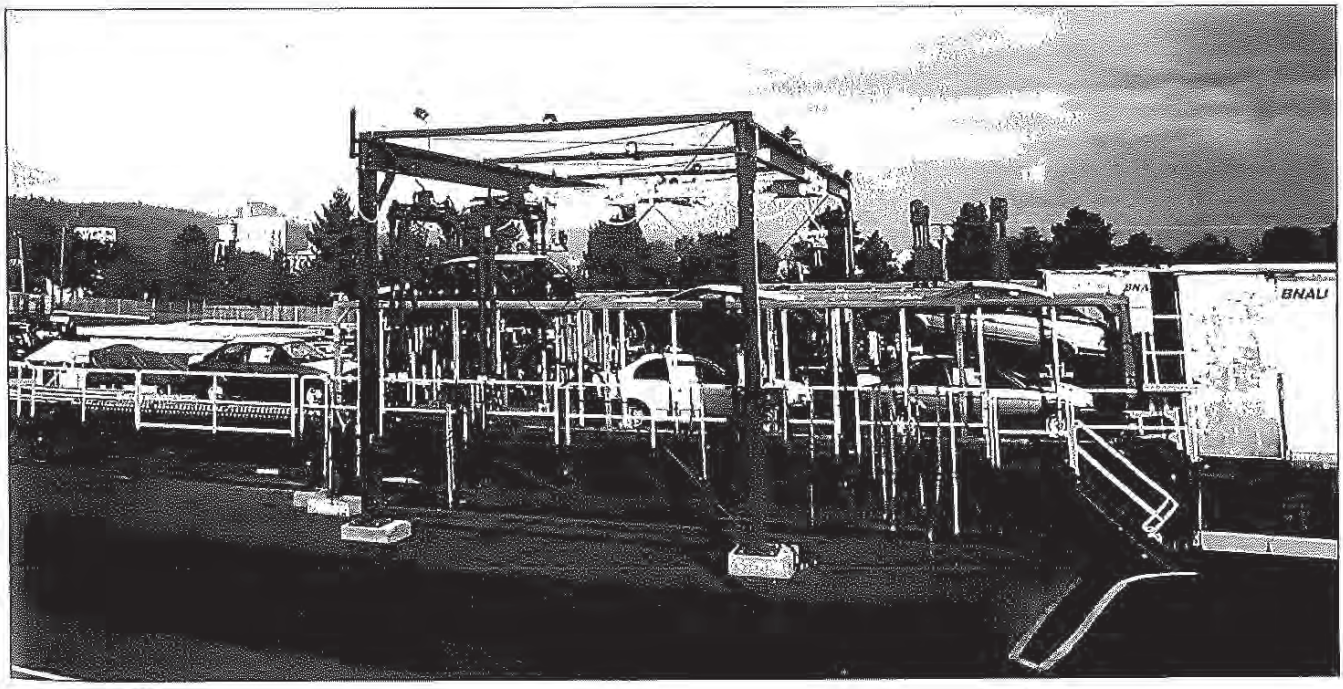


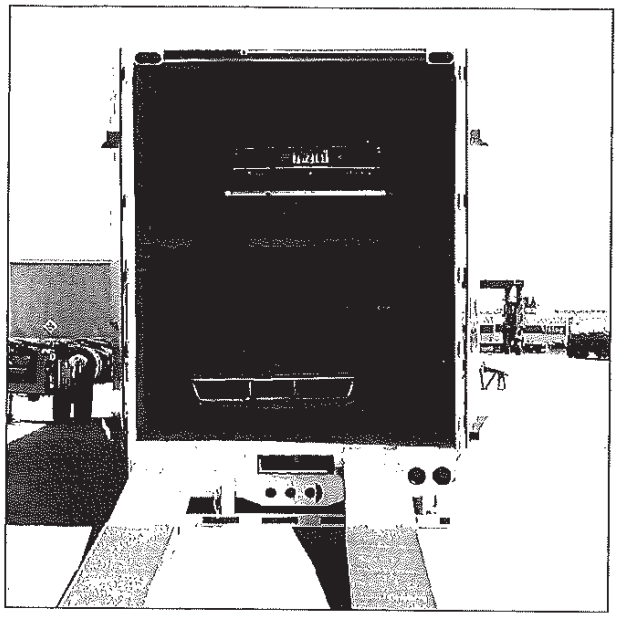
The Autostack® System

Autostack® is an internationally patented system designed to provide damage free, efficient containerized transportation of motor vehicles. It is a multi-modal product designed to carry international and domestic motor vehicles via rail, ocean and highway.

The rights to the Autostack system hardware includes loaders and racks that are manufactured to fit standard intermodal containers or trailers. Autostack racks are collapsible frameworks which are capable of handling vehicles (automobiles, vans, pick-up trucks) of the same or varying sizes at the same time. The racks are designed so that they can be collapsed and returned to the point of origin at the rate of six racks to one container, freeing the other five containers for other freight.

Using Autostack loaders, vehicles are loaded into racks externally, which are then inserted into intermodal containers or similar enclosures. Since Autostack racks are compatible with almost any type of enclosure, including domestic and international containers, intermodal trailers, RoadRailer and highway trailers, the Autostack system fits perfectly into the existing intermodal network.





AutoRailer™ *[Photo courtesy of Wabash National Corporation]*

AutoRailer™ / AllRailer™

Wabash National Corp., a manufacturer of truck trailers, has recently introduced two new vehicles for the movement of finished vehicles. Each in its own way represents a new approach. Wabash National's participation in the Future Distribution Systems Task Force process dates from the FDS kickoff conference which was held in February 1993. Prior to beginning design of the new vehicle transporters, Wabash set out on an extensive round of discussions with leaders in the field, coupled with financial analysis. The goal was to determine the important features that would be needed in the new vehicles, as well as the economic viability of the concepts, prior to making substantial investments in design, prototype and test.

Using this input, Wabash National set out to develop innovative new equipment for the movement of finished vehicles. As development efforts evolved, it was believed that two substantially different, yet complimentary vehicles were required by the marketplace:

1. "Direct-to-Dealer" market, which involved the movement of vehicles from plant, port or mixing center direct to dealer

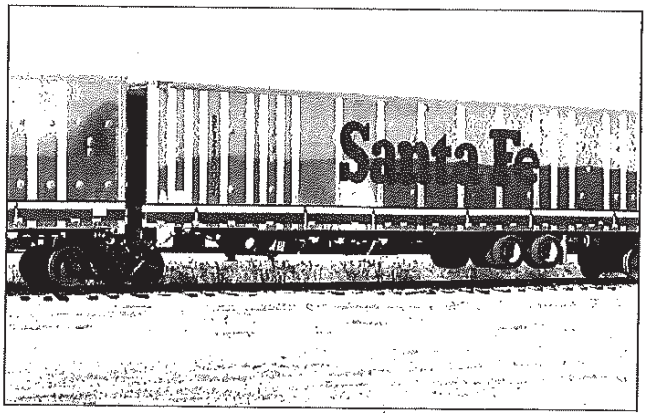
2. "Ramp-to-Ramp" market, which involved the movement of high volumes of vehicles from plant to mixing center or destination auto ramp for further movement by highway to dealer

Wabash National is now in the early stages of commercialization of its two new equipment concepts - the AutoRailer™ Trailer for the Direct-to-Dealer market, and the AllRailer™ Multilevel Railcar for the Ramp-to-Ramp market.

The AutoRailer Trailer is a specialized trailer based upon the RoadRailer™ bi-model rail/highway technology and is a 53' long "Ultra-Cube" trailer. It utilizes low-profile 19.5" tire technology to achieve an interior height which is substantially greater than conventional trailers. This interior height is critical to achieving a simple, reliable system for handling up to six full-size automobiles inside the fully enclosed trailer. Three autos are carried on the one-piece deck, with another three carried on the floor of the trailer. The height of the trailer enables the two layers of vehicles to be carried without nesting, providing for an exceptionally simple "drive-on, drive-off" load/unload system. On the highway, the AutoRailer trailer is hauled by a low profile tractor with a 39" high fifth wheel. This fifth wheel is adjustable so the tractor can also be utilized to haul conventional trailers.

As a RoadRailer trailer, the AutoRailer unit is equally at home on rail or highway. On rail, the AutoRailer rides on a standard RoadRailer rail bogie and may be freely intermixed with other RoadRailer trailers in the slack-free RoadRailer unit trains. The RoadRailer rail bogie is built using a premium rail truck. When combined with the RoadRailer slack free coupler, the unit provides an exceptionally smooth, fully-enclosed ride for the vehicles. The fully-enclosed trailer eliminates the airborne contamination of the vehicle's new paint.

At destination, the trailer returns to the highway and drives to the dealer. There, the loading process is reversed and the autos are unloaded by the single driver. No investment or additional area is required on the part of the dealer beyond that which the business currently devotes to accepting deliveries. The average time to unload a trailer is approximately 25 minutes from start to finish. The "two-way" capability of the AutoRailer offers substantial opportunities to take cost out of the logistics chain by reducing unproductive empty miles and increasing vehicle utilization. Given the minimal terminal requirements of the RoadRailer system, on-site RoadRailer terminals can be created at assembly plants, providing increased economic efficiency, particularly for "PIVOT" (Part In, Parts Out) operations. Additional economic savings result from the elimination of intermediate handling of the vehicles, with the associated inspection and damage costs.



AutoRailer™ *[Photo courtesy of Wabash National Corporation]*

By the end of 1996, several hundred AutoRailer trailers will be in service. The product of multiple manufacturers, representing European, Japanese and domestic U.S. producers are being handled in full commercial service over both rail and highway, in the United States and Mexico. In all cases, vehicles are being delivered direct to dealer.

Wabash National is continuing to refine the AutoRailer technology. Among the improvements currently underway is a "split deck" system, which will permit the handling of over-height vehicles such as minivans and pickup trucks. The trailer will be able to handle mixed loads of four autos and one truck, for a load factor of five units.

The second new Wabash National product is the AllRailer Multilevel Railcar. This unit is an ultra-lightweight, fully-enclosed, articulated railcar for transporting autos and trucks from ramp to ramp.

The AllRailer railcar is based upon the RoadRailer system. An AllRailer railcar is composed of any number of AllRailer units. Each unit is 57' long x 19' tall and is capable of handling nine autos on three decks or six trucks on two decks. Each AllRailer unit is equipped with a single rail bogie on the "B" end, as well as a beefed-up version of the RoadRailer female coupler slot and coupler pin. At the "A" end the unit has a large RoadRailer coupler tongue, which supports the nose of the unit and provides a slack-free articulated coupling between the units.

Each unit is equipped with bi-fold doors on both ends which may be opened while the units are coupled. Fold-down bridge plates are incorporated in each unit, allowing for easy drive-through loading and unloading. When the doors are closed the AllRailer unit provides a completely sealed environment for the vehicles. There are no openings to provide avenues for illegal entry. Contamination of the car's interior by metal dust and roadbed grit is eliminated.

Connection to conventional equipment is provided by removable knuckle couplers. At the "A" end of the car, a removable bogie equipped with a knuckle coupler is attached connecting to the RoadRailer coupler of the AllRailer unit. On the "B" end the coupler is contained in a removable "Coupler Plug" that inserts into the RoadRailer female coupler slot. The AllRailer design is

AllRailer prototype ready for FDSTF specification testing *[Photo courtesy of Wabash National Corporation]*

Unloading operation of AllRailer in Bi-Level Mode *[Photo courtesy of Wabash National Corporation]*

a modular system which may be utilized to assemble a slack-free articulated railcar of variable length. Anywhere from 1 to 100 units may be placed between the removable knuckle couplers of the AllRailer railcar.

For loading and unloading, the knuckle couplers are removed, allowing for a deck height which is lower than conventional autorack railcars, eliminating the ramps, and hinged decks which are required in conventional tri-levels to span the couplers between cars. The decks of the AllRailer are flat and the bridge plates span the gap between units without interruption. The distance between units is only 18" at the centerline of the car and 37" at the sidewalls.

The shorter, articulated design of the AllRailer concept reduces the distance between truck centers significantly when compared to the standard 89' autorack. This has permitted an increased interior width of 120" (11" wider than the autorack). As always, the goal is to provide for damage-free loading and unloading of the vehicles.

Door edge protection is provided throughout the unit. Vehicles are tied down using over-the-tire straps, two per vehicle on autos, and four per vehicle for trucks.

Interior lighting is provided by translucent panels in the roof of the AllRailer unit and by translucent portholes in the aluminum sides. The sides are solid, prepainted aluminum sheet with no openings. Ventilation is provided by the generous door openings between units every 57'.

The AllRailer units are equipped with Swing Motion™ trucks from National Castings. At testing on the AAR Pueblo, CO, test track the AllRailer units were run at speeds of up to 80 mph without showing any signs of instability or truck hunting. In addition, the slack-free articulated couplers of the AllRailer concept reduce the longitudinal forces resulting from the slack action of conventional railcars.

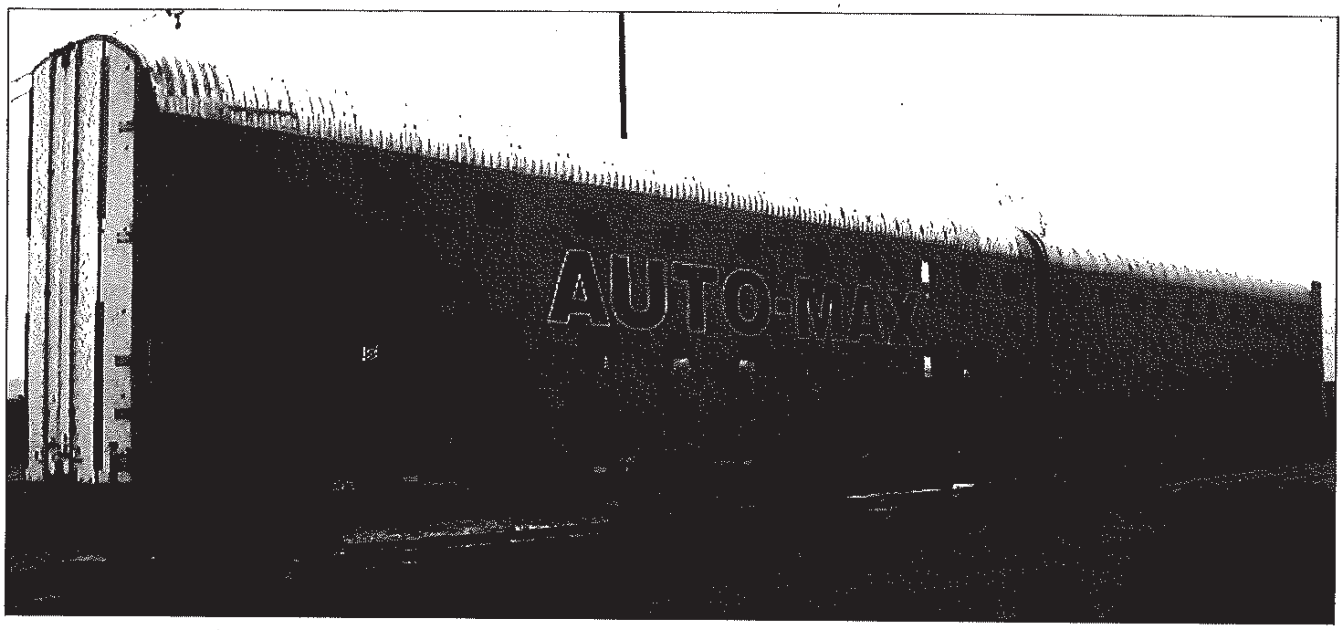
The AllRailer unit is available with a moveable deck system which allows the unit to be easily converted between bi-level and tri-level configurations. The two decks are nested together in bi-level mode. Each deck then provides the counterbalance to the other as the decks are moved apart to provide the tri-level configuration. The operation is totally manual, powered by one man

turning a crank on the side of the car. Total time required to unlock the decks, move the decks to the new position and relock is about four minutes.

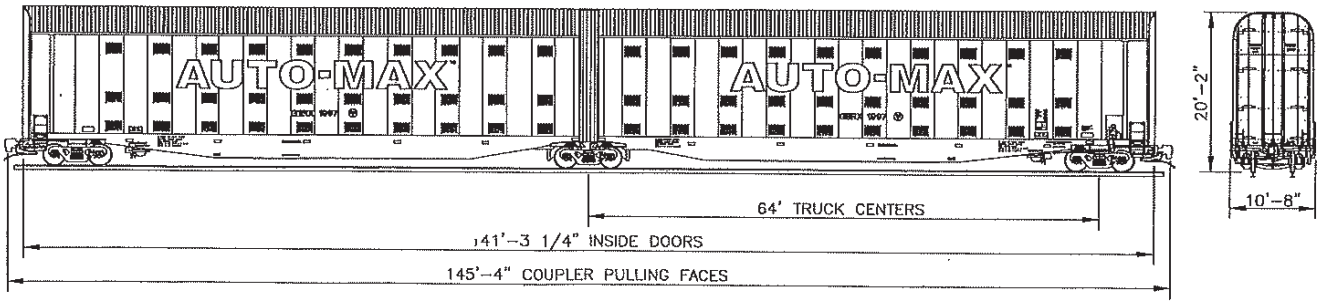
The AllRailer units are constructed using a blend of railcar and trailer design techniques, resulting in a railcar which is strong enough to meet full railcar strength standards, yet 25 to 33% lighter per auto or truck handled. The AllRailer unit may be operated at any location in conventional trains, yet it saves over one ton of dead weight per auto.

The initial AllRailer units were developed in partnership with the Santa Fe Railroad (now Burlington Northern Santa Fe), and the initial three-unit prototype set is now entering test commercial service to gain experience in order to guide design refinement for the production version. Prototype units were also constructed for Conrail and are expected to enter service during the fourth quarter of 1996.

Auto-Max™



AutoMax™ automobile carrier. *[Photo and illustration courtesy of Gunderson, Inc.]*



Auto-Max™ is a two-unit articulated automobile carrier car that can be configured for either tri-level or bi-level service. It is the only car in the industry that has the unique capability of carrying sport-utility vehicles in a tri-level configuration. This excess capacity gives the Gunderson car the highest load factor of any auto carrier. The three decks are adjustable to bi-level service for larger vans and trucks.

Specifications

Overall length of 2-unit car over coupler pulling faces	145'4"
Overall length, inside	141'5¼"
Width, outside at center of units	10'
Width, outside, extreme at ends of car	10'8"
Width, inside between side posts	9'3½"
Height, extreme, empty car	20'2"
Truck centers	64'0"

Dictionary

A

"A" End of Car A term used to identify locations on a car, being the end opposite the "B" end. The term is commonly seen with "L" or "R" to designate either left or right side, i.e. "AL" or "AR." See "B" End of Car.

"A" Level Protection Refers to tank bottom discontinuity shear off protection for any discontinuity extending more than "1" below the tank shell. All new cars since 1978 are built to "A" level requirements.

"A" Scale Sound Level A measurement of sound approximating the sensitivity of the human ear, used to note the intensity or annoyance of sounds.

"A" Unit A diesel locomotive unit equipped with a cab and operating controls. Also called a "lead unit."

AAR 206W AAR tank car class equivalent to a DOT 115A (tank within a tank) except the radioscopic examination of the inner tank welded joints is not a requirement. The tank car cannot be used to transport regulated materials.

AAR 211A AAR tank car class equivalent to DOT 111A except the radioscopic examination of welded joints is not a requirement. The tank car cannot be used to transport regulated materials.

AAR 203W AAR tank car class equivalent, with some exceptions, to a DOT 103W, insulated or uninsulated nonpressure cars with an expansion dome.

AAR 204 AAR tank car class similar in concept to a DOT 113W, they are vacuum insulated cars having an inner container and carbon steel outer shell.

AAR 207A AAR tank car class built for the transportation of granular commodities that are unloaded pneumatically.

AAR or A.A.R. (Association of American Railroads) An industry association whose responsibilities include safety standards (including design standards and approval), maintenance, operations, service and repair standards, and car service rules.

AAR Manual Of Standards And Recommended Practices (MSRP) Publication containing the technical specifications and quality assurance requirements for interchange freight cars and components. Considered mandatory when specifically referenced in AAR Interchange Rules.

Abatement Reducing the degree or intensity of, or eliminating, pollution.

AB Brake The standard freight car brake system which consists of the AB or ABD control valve, brake cylinder, auxiliary and emergency reservoirs, train line and other associated parts. The system allows rapid serial brake applications on each car in a train, controlled from the locomotive cab.

AB Brake Valve The operating control valve of the AB freight-car brake, consisting of three portions: the service portion, the emergency portion, and the pipe bracket. The AB valve controls the charging, application and the release of the air brakes on each car.

ABD Brake Valve A modification of the AB valve which is an integral part of the AB brake system for freight cars. The ABD valve substitutes certain internal parts, and features a quick release mechanism which facilitates rapid evacuation of air from the air brake cylinder. It was required for new cars until 1976. Now only allowed as a replacement in kind.

ABDW Brake Valve A further modification of the ABD valve involving a substitution of the emergency portion only. The ABDW valve provides accelerated buildup of brake cylinder pressure during service brake applications, and decreases the time required to achieve effective braking. The need for a B-1 quick service valve is eliminated when a car is equipped with the ABDW control valve. The ABDW valve was required on new cars from 1977 to 1992, now only allowed as a replacement in kind.

ABDX Brake Valve A further modification of the ABDW valve with increased service transmission rate, continuous quick service, leakage protection and stabilized emergency valve. Designed for cars with 75 feet or less of brake pipe.

ABDX-L Brake Valve A modification of the ABC+DX valve for use with cars having over 75 feet of brake pipe. The emergency portion has larger porting to compensate for longer cars.

ABDX-R Brake Valve Remanufactured ABD brake valves which are functionally similar to the ABDX valve and are used on cars with less than 75 feet of brake pipe.

ABEL EPA's computer model for analyzing a violator's ability to pay a civil penalty.

AC Traction Motor A multi-phase type electric motor operating on variable frequency alternating current. The frequency varies from zero to a value dependent upon the number of phases, motor design and the ultimate speed of the locomotive unit. Typically, AC traction motors operate on three phase current.

Accelerated Release A feature for making a quicker and more certain release after emergency application of brakes. It is accomplished by taking air from the auxiliary reservoir and the brake cylinder or the displacement reservoir and relay valve into the brake pipe, (back dump.)

Accelerated Release Rate Increasing the pressure in the brake pipe fast enough to cause the emergency piston to assume accelerated release position.

Acceleration Rate of change of speed miles per hour (change) per second or miles per hour per minute.

Acceptable Daily Intake (ADI) An estimate similar in concept to the RfD's, however, derived using a less rigorously defined methodology. RfD's have replaced the ADI as the EPA's preferred value for use in evaluating potential noncarcinogenic health effects resulting from exposure to a chemical.

Acceptable Intake for Chronic Exposure (AICs) An estimate similar in concept to the RfD's, however, derived using a less rigorously defined methodology. RfD's have replaced AICs as the EPA's preferred value for use in evaluating potential noncarcinogenic health effects resulting from exposure to a chemical.

Acceptable Intake for Subchronic Exposure (AIS) An estimate similar in concept to a subchronic RfD's, however, derived using a less rigorously defined methodology. Subchronic RfD's have replaced AICs as the EPA's preferred value for use in evaluating potential noncarcinogenic health effects resulting from exposure to a chemical.

Accessibility The extent to which facilities are barrier free and useable by persons with disabilities, including wheelchair users.

Accident Site The location of an unexpected occurrence, failure, or loss, either at a plant or along a transportation route.

Acclimatization The physiological and behavioral adjustments of an organism to changes in its environment.

ACI (Automatic Car Identification) Any system to provide for automated identification of cars in a train. The most common uses a set of 13 reflective "modules" on each side of a car, caboose, locomotive, container, or trailer, which identifies the owner, number and equipment classification, when read by an optical scanner.

Acid Deposition A complex chemical and atmospheric phenomenon that occurs when emissions of sulfur and nitrogen compounds and other substances are transformed by chemical processes in the atmosphere, often far from the original sources, and then deposited on earth in either a wet or dry form. The wet forms, popularly called "acid rain," can fall as rain, snow, or fog. The dry forms are acidic gases or particulates.

Acid Rain See Acid Deposition.

Acknowledge A manually operated electric switch or pneumatic valve by means of which, on a locomotive equipped with automatic train

stop or train control device, an automatic brake application can be forestalled, or by means of which, on a locomotive equipped with automatic cab signal device, the sounding of the cab indicator can be silenced. Sometimes called a "forestalling switch."

ACM (Asbestos-Containing Material) Any material that has been determined to hold asbestos, thus presenting the risk of airborne asbestos fibers.

Acoustic Emission Inspection/Testing A form of non-destructive testing for tank cars to detect materials and structural defects.

Activated Carbon A highly adsorbent form of carbon used to remove odors and toxic substances from liquid or gaseous emissions. In waste treatment it is used to remove dissolved organic matter from waste water.

Actuator A spring-opposed, diaphragm-actuated device first used to position the governor or the throttle of an engine.

Acute Exposure A single exposure to a toxic substance which results in severe biological harm or death. Acute exposures are usually characterized as lasting no longer than a day.

Acute Toxicity The ability of a substance to cause poisonous effects resulting in severe biological harm or death soon after a single exposure or dose. Also, any severe poisonous effect resulting from a single short-term exposure to a toxic substance. See Chronic Toxicity, Toxicity.

Adaptation Changes in an organism's structure that helps it adjust to its surroundings.

Adapter, Roller Bearing Casting that fits between a freight car roller bearing and the truck side frame to transfer the load from the side frame to the bearing. See Roller Bearing Adapter.

Additional Cost Charges included in Section D of Rule 107, AAR Field Manual, that are in addition to Settlement Value. See Settlement Value.

Additions Capitalized components added (not replaced) to existing equipment which are included in the investment account.

Add On Control Device An air pollution control device such as carbon absorber or incinerator which reduces the pollution in an exhaust gas. The control device usually does not affect the process being controlled and thus is added on technology, as opposed to a scheme to control pollution through making some alteration to the basic process.

Adhesion Coefficient of friction between wheel and rail for acceleration and retardation. When this force is exceeded, wheel slipping or sliding takes place.

Adhesion Coefficient The percent of the total weight on the driving wheels of a locomotive that is available for traction. It is largely dependent on the condition of the rail, and can vary from a low of 10% (.10) on wet rail to a high of 40% (.40) on dry sanded rail. Average coefficient of adhesion is about 0.25.

Adhesion (Environmental) Molecular attraction which holds the surfaces of two substances in contact.

Adhesion Limited Speed A speed at which adhesion (friction) between wheel and rail limits the acceleration possible from the available locomotive tractive effort horsepower. Attempting greater acceleration causes the locomotive wheels to slip.

Adhesion (of Drivers) A measure of the ability of locomotive driving wheels to accept rotational force without slipping on rails, usually expressed as a percent of the total weight on the drivers.

Adjusting Spring Used on a brake head to hold the brake shoe in its proper position. Used to bring the coupler back to central position after passing over a curve. Also used for moving four-wheeled trucks back to the central position when they have been displaced by passage over a curve. See Coupler Centering Device or Brake Head Adjusting Spring.

Adjustment Means provided for regulating or restoring devices to proper condition, such as taking up wear by spring, wedge, shims, etc.; slack of a train under conditions of starting and stopping or changing speed whereby the lost motion (slack) between cars is controlled to avoid damaging shocks.

Administrative Order A legal document signed by EPA directing an individual, business, or other entity to take corrective action or refrain from an activity. It describes the violations and actions to be taken, and can be enforced in court.

Advance (Internal Combustion Engines) Sometimes referred to as "lead or angle of advance," meaning the distance ahead of top or bottom dead center of the piston as measured in degrees of crank travel.

Advanced Public Transportation Systems (APTS) Intelligent Vehicle Highway Systems (IVHS) Technology that is designed to improve transit services through advanced vehicle operations, communications, customer service and market development.

Adverse Dynamic Behavior Any motion which is unfavorable to the movement of trains or individual cars, including rock-and-roll, truck hunting and vertical bounce. Extreme cases of these dynamics can cause derailment.

AEI (Automatic Equipment Identification) An automatic car scanning system to assist railroads in tracking and tracing cars. The system requires a transponder be mounted on diagonally opposite corners of each railcar.

Aeration A cleaning and purification process involving the exposure of water to intimate contact with air for the oxidation of iron or organic matter, and for washing out gases and odors.

Aeration (Environmental) A process which promotes degradation of organic water. The process may be passive (as when waste is exposed to air) or active (as when mixing or bubbling device introduces the air).

Aeration Tank A chamber used to inject air into water.

Aerial Tramway An electric system of aerial cables with suspended unpowered passenger vehicles. The vehicles are propelled by separate cables attached to the vehicle suspension system and powered by engines or motors at a central location not on board the vehicle.

Aerobic (Environmental) Life or process that require, or are not destroyed by, the presence of oxygen.

Aerobic Micro-organism (Bacteria) Contributing to Corrosion Needs oxygen for growth.

Aerobic Treatment Process by which microbes decompose complex organic compounds in the presence of oxygen and use the liberated energy for reproduction and growth. Types of aerobic processes include extended aeration, trickling filtration, and rotating biological contractors.

Aerodynamic Drag Resistance to motion due to air and wind divided by the weight of a train experiencing the resistance. Aerodynamic resistance divided by weight.

Aerodynamic Resistance Resistance to motion experienced by a train due to air and wind friction as the train or cars pass through the air. Aerodynamic resistance is proportional to the square of train speed.

Aerosol A suspension of liquid or solid particles in a gas.

Afterburner In incinerator technology, a burner located so that the combustion gases are made to pass through its flame in order to remove smoke and odors. It may be attached to or be separated from the incinerator proper.

Aftercooler A radiator unit for cooling compressed air after it has been heated by compression.

Air A train's air brake system, as in "to handle (operate) the air."

Air Arc or Arc Air (Welding) A metal cutting process wherein the severing of metal is effected by means of a chemical reaction of oxygen with the base metal at elevated temperatures, the necessary temperature being maintained by means of an arc between an electrode and the base metal.

Airborne Particulates Total suspended particulate matter found in the atmosphere as solid particles or liquid droplets. The chemical composition of particulates varies widely, depending on location and time of year. Airborne particulates include windblown dust, emissions from industrial processes, smoke from the burning of woods and coal, and the exhaust of motor vehicles.

Airborne Release Release of any chemical into the air.

Air Brake The general term used to describe the braking system used on most railways operating in North America. See AB Brake.

Air Brake Defects A term often used incorrectly in place of air brake troubles, but refers to improper manufacture as to material or workmanship.

Air Brake Equipment All of the brake system except the foundation brake rigging.

Air Brake Hose The flexible hose at each end of a car which is fastened to the brake pipe angle cock on one end, and has a fitting on the other end which engages with a similar coupling on an adjoining car. Sometimes known simply as " the air hose," or the "brake hose." See Trainline.

Air Brake Hose Clamp See Hose Clamp.

Air Brake Hose Coupling A special type of standardized fitting which is attached to one end of an air brake hose in order to provide means for rapid and positive connection and disconnection of the hoses between adjacent cars.

Air Brake Hose Nipple A short metal tube of standard AAR design formed on one end for forcing into the end of standard air brake hose where it is held by a suitable clamp. The other end of the nipple is threaded, and screws into the angle cock.

Air Brake Safety Control Commonly called "dead-man" feature. A system of devices which automatically cause the brake to be applied when the engineer becomes incapacitated or inattentive to duty. See Deadman Control and/or Alertness Control.

Air Brake System All of the devices and parts included in making an air brake for controlling the speed and stopping a locomotive or train. It is made up of the operating devices, the pipes, fittings, foundation brake gear, etc.

Air Cell A small receptacle connected to an engine cylinder into which some of the compressed air is forced, and through which air later flows into the cylinder to complete combustion of unburned fuel.

Air Changes Per Hour (ACH) The movement of a volume of air in a given time.

Air Compressor A power-driven air pump which on locomotives and self-propelled cars supplies compressed air for the operation of air brakes and other air-actuated equipment. Compressors may be driven from the engine or by an electric motor, either directly or through V-belts and pulleys.

Air Compressor Governor A device designed to automatically open or close the circuit to the electric motor driving the compressor, to unload the intake valve when the air pressure in the discharge line exceeds a predetermined limit, and again to start the operation of the compressor when the discharge air pressure falls below a predetermined limit.

Air Compressor Governor Synchronizing System An arrangement for ensuring an equal division of work of furnishing compressed air for braking and other purposes, among all motor or mechanically driven air compressors in a train.

Air Condenser A device used for removing moisture from compressed air by cooling the air.

Air Conditioning Broadly, the simultaneous adjustment of atmospheric conditions, chemical as well as physical, within an enclosed space, to suit the requirements of the purpose for which that space is used, regardless of variations in natural atmospheric conditions. This process involves control of moisture content, temperature, purity, circulation, and sound.

Air Contaminant Any particulate matter, gas, or combination thereof, other than water vapor or natural air. See Air Pollutant.

Air Filter A device for cleaning air, using felt in the cleaning element.

Air Gage (Air Brake) A dial type pressure measuring device used to register the pressure of air in the reservoirs, brake pipe or brake cylinders. Duplex gages with two pointers are available for measuring two pressures on the same dial face.

Air Gage Fitting A pipe connection by means of which an air gage is connected to the pipe or device containing the pressure that is to be measured.

Air Gap, Magnetic Air space between two adjacent parts of a magnetic circuit before the application of a protective coating.

Air Gaps The clearance between the armature core and the stationary field poles of a generator or motor.

Air Horn A warning device designed for locomotive applications which emits a loud sound when compressed air is supplied through a manually operated valve.

Air Hose Hose of air supply quality, usually red. Coatings, linings, mechanical. See Air Brake Hose.

Air Injection The system of injecting fuel into the combustion chamber of a diesel engine by means of a blast of highly compressed air.

Air Inlet Manifold A device having united channels for supplying air from the atmosphere, usually through a strainer or filter, to the air inlet valves of a compressor.

Air-Inlet Ports Openings through the cylinder liner of a two-cycle diesel engine, which are uncovered by the piston near its downward stroke, through which scavenging air and air for the next power stroke enters the cylinder. Exhaust may take place through ports at the opposite end of the cylinder in an opposed piston engine, or through exhaust valves in the cylinder head of a single-piston cylinder.

Air Intake Manifold A conduit with lateral connections clamped to the air inlet opening in each cylinder head through which air from the scavenging blower or supercharger passes to the inlet valves in each cylinder head. In some V-type engines it is formed by enclosing the "V" at the top of the cylinder block.

Air Motor A device actuated by compressed air, causing, producing, or imparting motion.

Air Pipe (Air Brake) More properly known as the brake pipe, and often called the "train line."

Air Pollutant Any substance in air which could, if in high enough concentration, harm man, other animals, vegetation, or material.

Air Pollution The presence of contaminant or pollutant substances in the air that do not disperse properly and interfere with human health or welfare, or produce other harmful environmental effects.

Air Pressure Governor Valve Used with water raising system for preventing the flow of air to the water raising system until air brake equipment is charged to a predetermined pressure; also prevents the flow of air from the water raising system to the air brake equipment.

Air Quality Criteria The levels of pollution and lengths of exposure above which adverse health and welfare effect may occur.

Air Quality Standards The level of pollutants prescribed by regulations that may not be exceeded during a specific time in a defined area.

Air Reservoirs Receptacles for storage of air for operating air brakes.

Air Signal See Back-Up Air Signal and Train Air Signal.

Air Space (Refrigerator Cars) Space purposely left between linings or layers of insulation in floor, sides, and ends, to provide additional insulation. It is sometimes called "dead-air space" as distinguished from the ventilating air passages, as the air in the former is confined and not constantly changing.

Air Spring An elastomeric unit inflated with low-pressure air used in the suspension system of transit cars or lightweight passenger cars. Pressure and thus vehicle height is maintained by a load level control device attached between the carbody and the truck.

Air Starter A device used to start an internal combustion engine by admitting compressed air into the cylinders.

Ajax Diaphragm A flexible fabric structure used to enclose vestibules between passenger cars.

Alarm Circuits Electrical circuits arranged to indicate faulty operation of any of the several systems which may be under an operator's control. Alarms may be indicated by bells, lights, or buzzers and other vital systems on a locomotive.

Alcove Lamp An interior light recessed in the side of a passenger car.

Alerter An electronic device to automatically cut off locomotive power and apply brakes in the event the locomotive engineer becomes incapacitated. See Deadman Control.

Alertness Control An electronic device to automatically cut off locomotive power and apply brakes in the event the locomotive engineer becomes incapacitated. See Deadman Control. See Air Brake Safety Control.

Algae Simple rootless plants that grow in sunlit waters in relative proportion to the amounts of nutrients available. They can affect water quality adversely by lowering the dissolved oxygen in the water. They are good for fish and small aquatic animals.

Algal Blooms Sudden spurts of algal growth, which can affect water quality adversely and indicated potential hazardous changes in local water chemistry.

Alignment Control Couplers Specially equipped couplers installed on some locomotives that will allow only limited lateral movement when in buff, and therefore reduce the possibility of rail turnover and jack-knifing of the locomotive consist.

Alloy Steel Steel to which has been added silicon, manganese, nickel, or other elements to give greater strength, or to impart other desirable properties for a particular use.

Alteration A change in tank or fittings that does not change the specification or class, but which does change the certification of construction, which requires an R-1 Form to be filled out. See Modification.

Alternate Method Any method of sampling and analyzing for an air pollutant which is not a reference or equivalent method but which has been demonstrated in specific cases to EPA's satisfaction to produce results adequate for compliance.

Alternate Standard A product or device which is approved by the AAR to serve as an acceptable requirement for use in interchange service.

Alternating Current An electric current that reverses its direction at regular intervals, usually abbreviated AC.

Alternative Fuels Low-polluting fuels which are used to propel a vehicle instead of high-sulfur diesel or gasoline. Examples include methanol, ethanol, propane or compressed natural gas, liquid natural gas, low-sulfur or "clean" diesel and electricity.

Alternator A device that generates alternating current electricity, or, an electrical machine on a locomotive unit and driven by the diesel engine. When rotated, the alternator generates alternating electrical current subsequently used by the traction motors. See Traction Motors.

Aluminum A light, silvery, malleable, and ductile metallic element. When alloyed with other elements, aluminum is used in railway car construction.

Aluminum Alloys Aluminum to which has been added various other elements to impart qualities suitable for a specific purpose. These alloys are available in the form of rolled or extruded structural shapes, castings, etc. for car construction.

Amalgamated Transit Union (ATU) A major labor union representing workers in the transit industry. Membership is limited to operators, mechanics and other nonsupervisory employees of the transit industry.

Ambient Air Any unconfined portion of the atmosphere: open air, surrounding air.

Ambient Air Quality Standards See Criteria Pollutants.

Ambient Temperature Generally refers to the temperature of the surrounding or encompassing atmosphere. This term is not definite unless accompanied by an actual temperature figure or range.

American Public Transit Association (APTA) The national, non-profit trade association representing the public transit industry. APTA members include more than 400 public transit systems, as well as state and local departments of transportation and planning agencies, manufacturers and suppliers of transit equipment, consultants, contractors and universities.

Americans With Disabilities Act of 1990 (ADA) A civil rights law passed by Congress in 1990 which makes it illegal to discriminate against people with disabilities in employment, services provided by state and local governments, public and private transportation, public accommodations and telecommunications.

Amfleet Cars Passenger type, non-powered rail cars designed for Amtrak intercity service.

Ammeter An instrument for measuring electric current in a circuit.

Amperage A unit of measure of electrical current. In metallic conductors, electrical current consists of the flow of electrons along the conductor.

Ampere The fundamental unit of measure for electric current. One ampere is defined as the current that flows when a potential of one volt is impressed on a resistance of one Ohm. See Ohm.

Ampere-Hour The quantity of electricity equivalent to a current of one ampere flowing past a point in a conductor in one hour. Sometimes simply called an "amp-hour."

Anaerobic Micro-organism growth contributing to corrosion where no oxygen is present.

Anchor (Construction) A device used in connection with rods, wires, ropes, bolts, or other connection supports, to give stability to the whole or part of a structure, or to secure it to a foundation.

Angle (Steel Structure) A general term applied to rolled steel structural members having an L-shaped cross section.

Angle Cock A special type of 1¼" valve of either ball or plug design, located at both ends of the brake pipe on locomotives and cars and used to control admission of air to the brake pipe on individual cars. The free end is angled at 45 degrees and is threaded to receive the air hose nipple.

Angle Cock Bracket A clamp or bracket for supporting the angle cock.

Angle Cock Handle The operating handle of the angle cock, having a self-locking feature to minimize the chance of accidental opening or closing of the valve.

Angle Cock Key A slightly conical plug, ground to fit the interior of non-ball type angle cock body, and having a rectangular opening through it so as to open communication between the two ends of the angle cock body.

Angle Fitting (Air Brake) A special pipe elbow for use with brake and signal pipe hose couplings.

Angle Globe Valve A globe valve having the inlet and outlet connections at an angle with each other, commonly 90 degrees.

Angularity of Choke Passage The angle of the passage with a choke in connecting one retainer head to the other.

Anhydrous Dry, free of water in any form.

Annealing A heat treating process whereby the temperature of an iron base alloy is raised and held above the transformation range for a time, followed by slow cooling, thereby equalizing internal stresses and increasing ductility.

Annual Element Those transportation improvement projects, contained in an area's Transportation Improvement Program (TIP), that are proposed for implementation in the current year. The annual element is submitted to the US Department of Transportation (US DOT) as part of the required planning process.

Annular Groove A ring-shaped groove.

Annunciator A device for visual signaling, having a number of pilot lights, each of which indicates the status of an associated circuit and is labeled for circuit identification. Annunciator panels are installed on modern locomotives.

API Gravity An arbitrary scale adopted by The American Petroleum Institute for measuring the specific gravity of a liquid in "degrees".

Application Consists of all of the operations from the time the brake pipe reduction is started until the brake is released.

Application Chamber A reservoir of such a volume provided in a distributing valve to be connected to the application cylinder for proper pressure equalization and stability of the application piston.

Application Chamber Pipe The pipe which connects the application chamber of the distribution valve with the automatic brake valve through the independent brake valve.

Application Circuit (Electro-Pneumatic Brake) An electric circuit maintained throughout the length of a train for controlling the application and release of air brakes.

Application Cylinder The moving space on the outer face of the application piston of a distributing valve where air pressure moves the piston and valves to cause a corresponding pressure to be supplied from the main reservoir to the brake cylinders. Also as the pressure is reduced, the piston and valves move and brake cylinder pressure is reduced an equal amount.

Application, Emergency An application resulting from an emergency rate of brake pipe reduction which causes the brakes to apply quickly and with maximum braking force for the shortest practical stopping distance.

Application for Approval The upper portion of the form AAR 4-2. This required form is submitted to the AAR for new tank cars, alterations and conversions. Relevant drawings accompany the submission. When the car design is approved the application is signed and returned to the car builder or company involved. See Certificate of Construction.

Application, Full Service Reducing the brake pipe pressure at a service rate until the reservoir and cylinder pressures equalize.

Application, Partial Service Reducing the brake pipe pressure at a service rate but not enough to cause the reservoir and cylinder pressure to equalize.

Application, Straight Air Applying the brakes by a direct operation other than by a brake pipe reduction, such as the electro-pneumatic operation with HSC equipment, as well as where air flow is directed from a supply through a brake valve into the brake cylinders on a locomotive.

Application Valve A slide or poppet valve used in a distributing valve opened and closed by movement of the application piston for admission of air from the main reservoir to the locomotive brake cylinders.

Application Zone A circular portion on the self-lapping valve or Controlair, over which the handle is moved to increase or decrease the delivered air pressure.

Applicator One who applies; tool for applying.

Apply, Applying Application To operate the brake system so that force through the foundation brake gear brings the brake shoes against the wheel tread or discs to cause friction for the purpose of retarding the motion or stopping the vehicle or train.

Approach Channel The passage through which the fluid must pass to reach the operating parts of a safety relief device.

Approval Withdrawn The status of a formerly approved design, product, device or facility which has been found to be no longer acceptable for use on or involving equipment in interchange service. When applicable, removal from interchange service may be required within prescribed time limits.

Approved The status of an item of equipment, practice, or procedure, design, product, device or facility which has been reviewed by the AAR Mechanical Division and found to meet the applicable requirements of an AAR Specification, Standard, Alternate Standard, or Recommended Practice. (AAR)

Appurtenance Any cargo tank accessory attachment that has no lading retention or containment function and provides no structural support to the cargo tank.

Arbitration Committee A standing committee of the AAR Mechanical Division whose duty it is to settle disputes arising between the members under the Rules of Interchange and to recommend changes, amendments or additions to the Rules of Interchange as may be thought advisable from the experience of the preceding years.

Arc (Electric) A luminous glow or bow of light formed when an electric circuit is opened between two electrodes or terminals. Heavy arcing is undesirable and is sometimes controlled or suppressed by a strong magnetic field.

Arc Gate Device that controls the flow of taconite onto the shuttle conveyor.

Arc Weld A welding process whereby coalescence is produced by heating with an electric arc, with or without the use of filler metal.

Armature The rotating part of a direct current motor or generator. It consists of a laminated iron cylinder or core keyed to a shaft, in the slots of which are wound the armature coils of insulated copper wire or bars. In alternating current machinery the armature is frequently the stationary element.

Armored Hose Air brake or signal hose covered with woven wire fabric, or other heavy material to protect it from injury or abrasion.

Articulated Car A car created by the uniting of two or more railcar segments or units to form a single unit whose joints are created by a drawbar or coupling included between the segments or units. Many articulated cars share a common truck under the articulated joints.

Aspect The appearance of a roadway (fixed) signal conveying an indication as viewed from the direction of an approaching train; the appearance of a cab signal conveying an indication as viewed by an observer in the cab.

Asphalt Residue from petroleum refining; also a natural complex hydrocarbon.

Assigned Car A railcar specifically designated for use of a particular shipper, or, in the case of private cars, for the use of a particular railroad for a specific service.

Association Of American Railroads See AAR.

At Abbreviation for the word atmosphere; is often used on diagrams to indicate an exhaust opening leading to the atmosphere.

Atmosphere Pressure Atmospheric pressure equals 14.696 psia (101.325 kPa[abs.]).

Atomization (of Fuel) The breaking up of fuel into a fine spray which mixes uniformly with the air as it enters the combustion chamber of a diesel engine.

Audible Cab Indicator A device (usually an air whistle) located in the cab of a locomotive equipped with cab signals and designed to sound when the cab signal aspect changes and to continue sounding until acknowledged.

Automatic Air Brake Pertaining to the air brake system used for stopping trains. The automatic air brake is controlled by a pressurized air pipe or brake-pipe which runs the length of the train. A drop or reduction in the pressure in this train line, called a brake pipe reduction (BPR), causes air brakes to apply on each car and locomotive unit. An arrangement of air brakes whereby air is stored in reservoirs in individual car reservoirs; an operating valve such as a triple, control, distributing, or AB valve causes the brakes to apply and release through the action of changing the brake-pipe pressure. A reduction of brake-pipe pressure causes the brakes to apply and an increase in brake-pipe pressure causes the brakes to release. See AB Brake.

Automatic Application Consists of all of the brake pipe reductions to apply and hold the brake applied until it is entirely released. A single application may be gradually applied by several brake pipe reductions or released by several graduations. The pneumatic control of brakes as distinguished from electro-pneumatic (straight air).

Automatic Brake The air brake system used on a train. The automatic brake is controlled by a pressurized air pipe or brake pipe which runs the length of the train. A reduction or drop in the pressure in this train line, called a brake pipe reduction (BPR), causes air brakes to apply on each car and locomotive unit.

Automatic Clutch (Generator Drive) A self-acting device which engages the driving mechanism with the generator when the speed of the former becomes sufficient, and disengages the two when the driving speed falls below a predetermined value.

Automatic Coupler See Coupler.

Automatic Double Acting Slack Adjuster See Slack Adjuster.

Automatic Drain Valve A valve which is actuated by compressed air and used in draining condensation from aftercoolers and reservoirs of locomotives.

Automatic Empty-And-Load Brake A modified AB freight car brake in which a changeover valve, activated by a device on one of the trucks which measures spring deflection, directs air from the AB valve to one brake cylinder when the car is empty and two brake cylinders when the car is more than half loaded.

Automatic Equipment Identification See AEI.

Automatic Lubricator A device for feeding at regular intervals a certain quantity of oil or lubricant to a mechanism requiring lubrication. See Lubricator.

Automatic Slack Adjuster See Slack Adjuster.

Automatic Split Reduction Automatically reducing the brake pipe pressure a few pounds at a normal service rate, then a continuous reduction at a slow rate, for the purpose of reducing the shock from take-up of train slack on long trains.

Automatic Train Control System (ATC) (1) A track-side system working in conjunction with equipment installed on the locomotive, so arranged that its operation will automatically result in the application of the air brakes to stop or control a train's speed at designated restrictions, should the engineman not respond. (2) When operating under a

speed restriction, an application of the brakes when the speed of the train exceeds the predetermined rate and which will continue until the speed is reduced to that rate. ATC usually works in conjunction with cab signals.

Automatic Train Operation (ATO) A system by which speed and other control signals from the wayside are automatically received and translated into train response with appropriate feedback to assure operating safety.

Automatic Train Stop System (ATS) A track side system working in conjunction with equipment installed on the locomotive, so arranged that its operation will result in the automatic application of the air brakes should the engineman not acknowledge a restrictive signal within 20 seconds of passing the signal. If the restrictive signal is acknowledged, ATS will be suppressed.

Auto Parts Car A boxcar specially fitted for transportation of automobile parts in racks without packing. Auto parts cars carry an AAR mechanical designation of "FA".

Auxiliaries The term applied to a number of separately driven machines, operated by power from the main engine. They include: air compressor, radiator fan, traction motor blower, exciter for the main generator, and the boiler blower. They are sometimes driven electrically and sometimes by mechanical means.

Auxiliary Brake Equalizing Lever (Six-Wheel Truck) A short lever to which the brake lever connecting rod is fastened, and which divides the power equally between the center pair of wheels and the outside pairs of wheels.

Auxiliary Drive The mechanism of belts, shafts, gears or motors required to take power from the engine to the auxiliaries.

Auxiliary Generator A generator provided to produce power for the various fuel, oil, and water pumps and to recharge the storage battery. This machine is generally driven by belts from the diesel or gears from the main generator. Passenger locomotives have an auxiliary generator for train lighting and sometimes heating.

Auxiliary Reservoir A part of the air brake equipment on each railway car. Compressed air is stored in the auxiliary reservoir and is admitted to the brake cylinder to apply train brakes when brake pipe pressure is reduced. The auxiliary reservoir is isolated from the emergency reservoir by a separator plate bolted between the halves of the large reservoir tank on each car.

Axle Centering Machine A machine used to cut the conical holes or lathe centers in the ends of axles.

Axle Collar A rim or enlargement on the end of a car axle, which takes the end thrust of the journal bearing.

Axle Generator A special type of electrical generator designed to be driven from the car axle by belt and pulleys or gear drive. Small axle generators for caboose power supply, for locomotive wheel slip control, etc., are driven from a connection with one end of an axle through a gear and splined shaft drive.

Axle Pulley Bushing A bushing or sleeve, split longitudinally and bored conically inside to fit the tapering car axle and turned cylindrically outside to fit the hub of the axle pulley.

Axle Pulley The belt pulley mounted on the car axle for driving an axle generator.

Axle Seat The cylindrical surface of a car wheel which comes in contact with the axle (also called "the wheel bore"). The corresponding part of an axle is called "the wheel seat". Both surfaces are critical for a proper wheel fit on the axle.

Axle Spline Bushing A steel cylinder pressed into the end of an axle at the axle center for driving control devices.

Axle The steel shaft on which the car wheels are mounted. The axle holds the wheels to gage and transmits the load from the journal bearing to the wheels. See Black-Collar Axle.

B

"B" End of Car The end on which the hand brake is located. If the car has two hand brakes, the "B" end is the end toward which the body-mounted brake cylinder piston moves in the application of brakes. If the car has two hand brakes, the "B" end is the end on which the retaining valve is located (if such a valve is used). If none of the above definitions are applicable, the car owner shall arbitrarily designate the "B" end.

"B" Unit A diesel unit without a cab and without complete operating controls. "B" units are usually equipped with hostler controls for independent operation at terminals, and engine houses.

B-612 Magnetic Gauging Device A gauging device manufactured by Midland Manufacturing Company. This device can be used on both non-pressure and pressure cars.

Babbitt Metal An alloy, consisting of tin, copper, and antimony, sometimes used for lining journal bearings. The term is commonly applied to any white alloy for bearings. Lead bearings are different in that they merely use a thin sheet of lead over the brass to correct slight irregularities and give an even bearing surface.

Back Cylinder Head (Air Brake Cylinder) See Non-Pressure Head.

Back Dump The flow of air from the auxiliary reservoir and brake cylinder, or displacement reservoir and relay valve, into the brake pipe during accelerated release.

Background Level In air pollution control, the concentration of air pollutants in a definite area during a fixed time prior to the starting up or on the stoppage of a source of emission under control. In toxic substances monitoring, the average presence in the environment, originally referring to naturally occurring phenomena.

Back-Up Air Signal A warning whistler which can be operated from the rear of the train when backing up. Air for its operation is taken from the train line.

Back-Up Valve A device, either portable or permanently installed, provided for the purpose of controlling brakes from the rear end of a train. It may have a whistle.

BACT (Best Available Control Technology) An emission limitation based on the maximum degree of emission reduction which (considering energy, environmental, and economic impacts and other costs) is achievable through application of production processes and available methods, systems, and techniques. In no event does BACT permit emissions in excess of those allowed under any applicable Clean Air Act provisions. Use of the BACT concept is allowable on a case by case basis for major new or modified emissions sources in attainment areas and applies to each regulated pollutant.

Bacteria Microscopic living organisms which can aid in pollution control by consuming or breaking down organic matter in sewage, or by similarly acting on oil spills or other water pollutants. Bacteria in soil, water or air can also cause human, animal and plant health problems. The singular form of a bacteria is bacterium.

Bad Order (Noun) A car which is in need of mechanical attention or repairs.

Bad Order (Verb) During car inspection activities, the act of designating a car as a bad order car. Bad order cars may usually be identified by a distinctive cardboard tag tacked to the route board on the car.

Bad Order Car An interchange freight car which is in need of mechanical attention or repairs as defined in the AAR Interchange Rules or by governmental regulatory agencies.

Bad Order Track A track on which bad order cars are placed either for light running repairs or for subsequent movement to repair tracks.

Badge Plate A metal plate with stamped or engraved information about some significant aspect of the equipment to which it is attached.

Baffle A flat or curved plate sometimes mounted below safety valves or safety vents to minimize accidental valve leakage or disc breakage due to surging commodity.

Baghouse Filter Large fabric bag, usually made of glass fibers, used to eliminate intermediate and large (greater than 20 microns in diameter) particles. This device operates in a way similar to the bag of an electric vacuum cleaner, passing the air and smaller particulate matter, while entrapping the large particulates.

Balance Speed A speed at which the tractive effort of the locomotive exactly balances or equals the sum of all the train drag forces and grade and curve drag forces. At balance speed, there is neither acceleration nor deceleration.

Baling Compacting solid waste into blocks to reduce volume and simplify handling.

Ballast Material selected for placement on the roadbed for the purpose of holding the track in line and at surface.

Ballast Car A car for carrying ballast for repair and construction work, usually of either the flat, gondola, or hopper typed.

Ball Check A check valve with a ball for the valve.

Ball Choke A ball so fitted in its seat as to permit the air to pass at a restricted rate. It is not necessarily a check valve.

Ball Valve A valve named because of a steel or brass ball which serves as its key operating part and opens to a full discharge rate with only a 90 degree turn of the handle. The ball has a passageway which permits flow of product through the valve if the passageway is in alignment with the valve opening. When the ball is rotated, the flow of product is cut off.

Banking A system for recording qualified air emission reductions for later use in bubble, offset or netting transactions.

Bar (Car Work) A long steel rod used for prying, lifting and other heavy work.

Barrier Blocking or shielding devise.

Bath Tub Ring A corrosion phenomenon that decreases the tank's thickness when commodity residue is allowed to remain in the tank when water is loaded. Mainly found after tank testing.

Battery A group of cells connected together and capable of producing a direct electric current (DC) by chemical action when the positive and negative terminals are connected together through an electrical circuit. Common usage permits application of this designation also to a single cell used independently.

Battery Box A container usually suspended from the underframe of passenger cars, locomotives, and cabooses. It houses the electric storage batteries used for car lighting, air conditioning, engine starting, etc.

Battery Charger A device for restoring the electrical charge in a battery.

Battery-Charging Receptacle A receptacle for charging a locomotive, car or caboose battery from an external source of power.

Bay Window Caboose A caboose car having side bay windows instead of a cupola. This permits the train crew to look along the side of a train, especially when rounding curves, for detection of hot boxes or other trouble.

Bead A small projecting molding of semi-circular section. Also, the strips on the sash frame which form a guide for the sash. These beads are known as the "inside bead", "outside bead", and "parting bead".

Bead Weld A type of weld characterized by the deposition of weld metal in a narrow unbroken string on the base metal.

Beam A general term used in engineering construction that applies to the withstanding of bending stresses. In car construction the sills are fundamentally beams. Brake beams are part of the foundation brake apparatus.

Bearing That which supports or on which something rests and is in contact. The metal block or bushing in contact with a journal is called a "bearing." See Journal Bearing, Rolling Bearing and/or Side Bearing.

Bearing Drag (1) Drag due to resistance, usually the result of friction, within the bearing. (2) Speed independent portion of drag attributed to bearings at each end of the axles on a wheel set. See drag.

Bearing Metal An alloy of copper and tin or tin and zinc to which antimony and lead are sometimes added for use in engine and car journal bearings. See Babbitt Metal.

Bed Plate The structure on which the engine frame is supported and bolted to the locomotive frame, of which the oil pan is an integral part.

Bee Screen A screen covering an opening into a tank (commonly the air inlet of a corn syrup car) to prevent bees and other insects attracted by the commodity, from entering the tank.

Bell A warning device on a locomotive or self-propelled car. It is usually bell-shaped and is equipped with a ringer which is operated by the engineman.

Bell Crank A pivoted crank having two arms usually at right angles to each other and in the same plane for changing the direction of force 90º, more or less (vertical to horizontal). Bell cranks are used on freight cars in the hand brake system, in this usage it may or may not have a mechanical advantage.

Belly Band See Center Band.

Belt A band of flexible material, passing around two pulleys, communicating motion from one to the other. They may be flat or of "V" cross section, the latter usually being used in multiple.

Belt Rail A perforated structural angle attached to the interior sidewalls of a boxcar and used to locate and lock cross bars for providing landing restraint.

Benthic Region The bottom layer of a body of water.

Betterments Capitalized improvement of existing parts through the substitution of superior for inferior parts replaced on a freight car.

Bias A term used to indicate the constant force imposed on a piston, diaphragm, etc., to hold it in one position.

Bi-Level Car A flat car designed with integral superstructure of posts, bracings and decking to permit loading of set up automobiles on two levels. In passenger car construction, design which places passengers on two levels through the length of the car.

Billet Car A low side gondola car built of steel throughout for transportation of steel billets or other heavy material.

Billing Card Holder A holder for billing instructions generally mounted on the end platform or on the sides of the body bolsters.

Billing Repair Card The card which, under AAR Interchange Rules, is furnished to the car owner when repair work is done on a foreign car. The form and data contained on the card are specified in The AAR Interchange Rules.

Bill Of Lading A non-negotiable document by which a transportation line acknowledges receipt of freight and contracts for its movement.

Bioaccumlative Substances that increase in concentration in living organisms (that are very slowly metabolized or excreted) as they breathe contaminated air, contaminated water, or eat contaminated food.

Bioassay Using living organisms to measure the effect of a substance, factor, or condition by comparing before and after-data. Term is often used to mean cancer bioassays.

Biochemical Oxygen Demand (BOD) A measure of the amount of oxygen consumed in the biological processes that break down organic matter in water. The greater the BOD, the greater the degree of pollution.

Biodegradable The ability to break down or decompose rapidly under natural conditions and processes.

Biological Oxidation The way bacteria and microorganisms feed on and decompose complex organic materials. Used in self-purification of water bodies and in activated sludge waste water treatment.

Biological Treatment A treatment technology that uses bacteria to consume waste. This treatment breaks down organic materials.

Biomass All of the living material in a given area; often refers to vegetation. Also called "biota."

Biosphere The portion of Earth and its atmosphere that can support life.

Black Box A generic term used to describe an unspecified device which performs a special function or in which known inputs produce known outputs in a fixed relationship.

Black-Collar Axle An alternated standard design of freight car axle for plain bearings, referred to as the black-collar design because of the black colored, or "as forged" collar at the inside edge of the wheel seat. This type of axle is no longer produced.

Blanket Authority Preestablished dollar limits under which a car can be repaired without approval.

Bleed A term commonly used for draining or emptying a reservoir, pipe, equipment, etc., of air.

Bleeder A term commonly used for the release valve or a duplex release valve.

Blind-End Car A term applying to the end construction of baggage, express post or some passenger carrying cars having no external platform or vestibule.

Blister A lesion in a AHF tank car of at least ¼ inch (6.35mm) depth, or height, and of a diameter greater than three inches (76.2mm).

Block A length of track of defined limits, the use of which is by trains and governed by block signals, cab signals, or both.

Block, Absolute A block in which the testing, service, repair, inspection, or rebuilding of railroad rolling equipment is under the exclusive control of mechanical department personnel.

Blocking and Bracing (Procedures) Safety precautions in loading of rail shipments, which must be in accordance with regulations of the ICC, FRA and the AAR

Blow Unintended flowing of air or steam to the atmosphere, making audible sound such as caused by leaks, etc.

Blowdown Refers to reduction of pressure through exhausting the air.

Blower A general term applied to a group of machines, the functions of which are to propel air for ventilation or cooling or other uses.

Blue Flag A blue signal (flag by day, light at night), displayed at one or both ends of an engine, car or train, indicating that workmen are on, under or between railcars. When thus protected, the engine must not be coupled or moved. Each class of workmen will display the blue signals and only these same workmen are authorized to remove them. Other equipment must not be placed on the same track so as to obstruct the view of the blue signals without first notifying the workmen.

Boarding Car A car used as a place of lodging for workmen.

BOD5 The amount of dissolved oxygen consumed in five days by biological processes breaking down organic matter.

Body Bolster Bottom Cover Plate A plate or casting forming the filling piece between the cover plates of a built-up body bolster. The term also applies to "truck bolsters".

Body Bolster Top Cover Plate The top cover plate used on a body bolster of the built-up type.

Body Center Plate A cast or forged steel plate riveted or welded to the body bolster at the car center line, the function of which is to transmit the body bolster load to the trucks through the truck bolster. See Truck Center Plate.

Body Cross Tie A metal bar extending across a hopper or other form of open-top freight car and fastened to the sides to prevent their bulging.

Body End Plate A transverse member in the end of a car connecting the side plates. See End Plate.

Body Framing The framework of that part of a car above the underframe, so called to distinguish it from the underframe. It is commonly subdivided into side, end and roof framing.

Body Mounted Brake System A car brake system in which the brake cylinder and other components are attached to the car-body. A system of rods and levers translates the brake cylinder force to the brake beams. See Brake Rigging.

Body Mounted Brakes Car air brakes whose levers, rods, cylinder and other components are supported by brackets attached to the carbody.

Body Post (Freight Cars) An upright piece which is fastened to the sill and plate of a freight car. The body posts and corner posts form the vertical members of the side frame of a carbody.

Body Side Bearing A flat steel bearing pad fastened to the body bolster, a standard distance outboard from the center pin hole, the function of which is to support the load of a moving car when variations in track cross level or other train dynamics cause the car to rock transversely on the center plates. A conventional car has four body side bearings (one at each corner).

Body Spring See Bolster Spring.

Body Transom A name sometimes given to a "needle beam" or "cross-bearer".

BOE Bureau of Explosives, the branch of the AAR that publishes Hazardous Material Regulations of the US Department of Transportation.

BOE-6000 Bureau of Explosives Tariff.

Bogie The running gear of a highway semi-trailer which may be removable or longitudinally adjustable. Also, the European railway term applied to railway freight and passenger car trucks.

Bogus Plate (Refrigerator Cars) A horizontal member attached to the posts on the inside of the car, a short distance below the plate. The bogus plates support horizontal cross members called meat racks, or hanging bars, to which hooks are attached for hanging meat.

Bolster See Container Bolster, Truck Bolster.

Bolster Anchors Rods, one at each end of the bolster of passenger car trucks, the ends of which are mounted in rubber, one on an arm integral with the truck frame and the other on the end of the bolster. The rubber mounting permits the rods to guide the lateral and vertical movement of the bolster. They position the bolster so that it is always free from contact with the truck transoms.

Bolster Bottom Cover Plate In a fabricated body bolster, the heavy steel plate forming the bottom over between the two vertical web plates.

Bolster Center Filler A box-shaped member placed between the center sill web plates and body bolster plates to reinforce the bolster at the center plate location.

Bolster Diaphragm See Bolster Webs.

Bolster Gibs Small projections at each end of a truck bolster that engage the side frame column guides and provide vertical guidance for the bolster and lateral restraint to the side frames when assembled as a truck.

Bolster Hanger Carrier A swing hanger pin bearing.

Bolster Hanger See Swing Hanger.

Bolster Jack Screw (Wreck Cranes) A jack screw attached to the spring plank for the purpose of taking the load off the springs and making the entire truck and carbody one rigid structure when the derrick of the crane is in use.

Bolster Pad A plate welded directly to the exterior of the tank at each body bolster location to which the remaining body bolster structure is attached.

Bolster Roll Stabilizer A device consisting of a separate spring plank on each side of the truck. These are connected across the truck by levers pivoted to the bolster and linked together at the center, thus transferring excess load on bolster springs at one side back to the other side and preventing the bolster from moving out of plane with the track.

Bolster Snubber One of several snubbing devices for dampening the synchronous vibrations of truck springs. Older devices consist of friction springs inserted among the coil bolster springs of freight car trucks. Sometimes called "spring dampener".

Bolster Spring The main spring of a car, supporting the truck bolster, on which the weight of the carbody rests.

Bolster Stiffener A steel block or weldment placed between the webs of a body bolster, over the side bearings, to reinforce the bolster bottom cover plate, and provide for better distribution of the side bearing loads.

Bolster Top Cover Plate In a fabricated body bolster, the heavy steel plate forming the top cover between the two vertical web plates.

Bolster Webs In a fabricated body bolster, the vertical steel plates forming the filling pieces between the top and bottom cover plates.

Boom A floating device used to contain oil on a body of water.

Boom Car A wreck train car using a derrick over which the derrick's boom rides.

Bottom Connecting Rod The brake rod connecting the bottom ends of the live and dead truck brake levers.

Bottom Outlet Valve A valve located at the bottom center of the tank through the tank contents can be unload.

Bottom Protection The various structural means used to protect bottom outlet valves, washouts, sumps, etc.

Bottom Rod The brake rod connecting the bottom ends of the live and dead truck brake levers. The bottom rod is sometimes called the "bottom truck connection" or the "spreader." See Brake Rod.

Bottom Rod Guard Name applies to devices designed to support the bottom rod and prevent it from dropping to the track in case of failure of any part which normally supports the bottom rod. Also called "safety support".

Bottom Rod Safety Support A device designed to support the bottom rod and to prevent it from dropping to the track in case of failure of any part which normally supports the bottom rod.

Bottom Truck Connection The common name for a "bottom connecting rod".

Bottom Unload See Bottom Outlet Valve.

Bottom Washout Bottom tank outlet used only during tank cleaning/washing/rinsing operations. Not used to unload tank commodity.

Boxcar A closed car having a floor, sides, ends and a roof with doors in the sides, or sides and ends. Used for general service and especially for lading which must be protected from the weather.

Box Car Door Used on the side of all box cars.

Box Lid See Journal Box Lid.

Box Section A structural member, usually a weldment, whose cross-section is of rectangular shape.

Brace An inclined piece which unites two or more of the points of a frame or truss, where other members of the structure are connected together and which prevents them from turning about their joints.

Bracing Protection of the contents (lading) of a car from shifting and subsequent damage.

Brake The whole combination of parts by which the motion of the locomotive, car or train is retarded or arrested. The foundation brake gear includes all of the parts by which the pressure of the air in the brake cylinder, or hand brake forces, is transmitted to the wheels. See Air Brake, Automatic Air Brake, Brake Beam, Brake Lever, Freight Car Brake, Hand brake, High Speed Brake, Independent Brake, Straight-Air Brake, Truck Mounted Brake, Vacuum Brake.

Brake Adjuster See Slack Adjuster.

Brake Application Valve A device used in connection with safety (dead-man) control, overspeed control, train (speed or stop) control for the purpose of causing a brake pipe reduction (service or emergency) independent of the engineman. A valve which is sometimes, but not always, installed in the branch pipe between the emergency brake (conductor's valve) and the brake pipe. It releases brake-pipe air to the atmosphere when the emergency brake valve is operated.

Brake Application, Full Service An application of the brakes resulting from a continuous or a split reduction in brake pipe pressure at a service rate until maximum brake cylinder pressure is developed. As applied to an automatic or electro-pneumatic brake with speed governor control, an application other than emergency which develops the maximum brake cylinder pressure, as determined by the design of the brake equipment for the speed at which the train is operating.

Brake Application The term used to describe the act of applying the brakes, generally accomplished by operating the automatic brake valve on a locomotive.

Brake Balancer A modification in the foundation brake rigging whereby the top of the dead lever is connected to the carbody instead of to the truck bolster. The object of the device is to relieve the truck from unbalanced stresses.

Brake Beam The immediate supporting structure for the two brake heads and two brake shoes acting upon any given pair of wheels. In freight service the virtually universal type is of truss construction consisting primarily of tension and compression members fastened at the ends and separated at the middle by a strut or fulcrum to which the truck brake lever is attached. Brake beams are said to be inside hung or outside hung, according to whether they are in the space between the axles or outside the axles.

Brake Beam Adjuster Hanger A link sometimes attached to a brake beam to cause the brake beam, brake head and shoe to maintain the same relative position when the brakes are released so as to prevent the brake shoes from coming in contact with the wheel when the brakes are released. It is attached to the truck transom by a projecting brake beam adjusting hanger carrier and to the brake beam by an eye or clip. Sometimes called a "parallel brake hanger".

Brake Beam Fulcrum See Brake Beam Strut.

Brake Beam Hanger A rod or bar by which a brake beam is hung or suspended from a truck. More commonly referred to as "brake hanger."

Brake Beam Safety Support Usually a rigid angle or bar attached to the truck spring plank, passing underneath the beam, to prevent beams from falling to the track as in the case of broken beam hangers, etc.

Brake Beam Strut The structural member between the tension and compression members of a brake beam; to which is attached the truck brake lever. Also called "brake lever fulcrum."

Brake Beam Support A special type of spring attached to the spring plank or par of the truck and supporting the brake beam by means of a sliding chair casting which is attached to the brake beam.

Brake Beam Supports Cast integral slots in truck side frames for supporting the ends of the brake beam.

Brake Beam Truss Rod The tension member of a build-up brake beam.

Brake Carrier See Brake Hanger Bracket Or Carrier.

Brake Chain The chain that connects the hand brake to the brake cylinder push rod.

Brake Chain Connecting Rod A rod connecting the hand brake chain to one of the brake levers, usually the floating lever or the cylinder lever.

Brake Chain Drum The enlarged end of the hand brake shaft on which the chain is wound.

Brake Chain Sheave An iron wheel or pulley around which the brake chain passes.

Brake Chain Worm (In Horizontal Wheel Hand Brake Systems) A conical casting attached to the brake shaft with a helical external groove for the brake chain. Its objective is to produce a rapid motion at first and increase the power when the brake shoes are brought to bear against the wheel.

Brake Clevis A "U" shaped steel section with pin holes in each leg for making a connection between a brake rod and a brake lever.

Brake Connecting Rod The rod (or rods) transmitting braking force from the cylinder levers to the truck live levers.

Brake Connection A rod usually made with jaws on the ends to fit over the brake levers. It transmits the pressure on the brake cylinder piston from on brake lever to another and finally to the brake shoes. The rod takes its name from the brake lever to which it is attached which is farthest from the cylinder. See Brake Rod.

Brake Connection Pin A pin used for connecting brake rods and levers.

Brake Cut-out Cock See Cut-out Cock.

Brake Cylinder A steel cylinder attached to the body frame or truck frame of a car or locomotive containing a piston which is forced outward by the compressed air to apply the brakes. When the air pressure is released, the piston is returned to its normal position by a release spring coiled about the piston rod inside the cylinder. Certain designs incorporate the brake cylinder as part of the brake beam or as part of the truck itself. See Truck Mounted Brakes, WABCOPAC, NYCOPAC.

Brake Cylinder Displacement The change in cubic measure of the volume of the brake cylinder when the brake cylinder piston moves its full travel as compared to its volume with the piston in release position.

Brake Cylinder, Double-Acting Brake cylinders with piston having two packing cups with opposite position flares. The piston is forced inward or outward in the cylinder, depending on which end of the cylinder air is admitted to.

Brake Cylinder, Duplex A brake cylinder having two pistons moving in opposite directions at the same time when compressed air is admitted to the center of the cylinder, the air being admitted between the two piston heads.

Brake Cylinder Force The power produced from the compressed air acting upon the brake cylinder piston and delivered to the foundation brake gear.

Brake Cylinder Lever See Cylinder Lever.

Brake Cylinder Lubricator A device for supplying oil or grease to the brake cylinder.

Brake Cylinder Pipe (Car) The pipe that connects the brake cylinder to its operating valve. The pipe that connects the distributing valve to all the brake cylinders in the locomotive brake equipment.

Brake Cylinder Plate The steel plate to which a brake cylinder is bolted and by which it is attached to the sills when the brake cylinder is attached to the carbody.

Brake Cylinder Protector A treated canvas bag designed to fit the inside of brake cylinders and protect the interior of the cylinder from dirt.

Brake Cylinder Release Valve A valve inserted in the brake cylinder pipe and mounted on the pipe bracket of the freight brake control valve. Its function is to permit the release of brake cylinder pressure without depleting the auxiliary or emergency reservoirs and brake pipe pressure. The ABD valve incorporates this feature in the service portion. It is operated by pull rods from the side or the car.

Brake Cylinder Tee A device containing a check valve and choke fitting used with the empty and load brake. It is to control the flow of air into and out of empty brake cylinder to protect the latching mechanism of the load brake cylinder.

Brake Equalizer See Floating Lever.

Brake Equipment That part of the air brake apparatus on railway vehicles that performs the operations necessary for supplying and exhausting air to and from the brake cylinders, but does not include foundation brake gear, hand brake, etc.

Brake Hanger That part of the foundation brake gear holding the brake shoe in position. It is attached to the truck by a brake hanger pin or carrier. Friction with the wheel tends to change its position either up or down depending on which way the wheel is turning.

Brake Hanger Bracket Or Carrier A casting or other fastening by which a brake hanger is attached to the truck frame.

Brake Head A casting attached to a brake beam which carries the detachable brake shoe.

Brake Head Adjusting Spring A spring attached to the brake head for the purpose of holding the shoe in alignment and still allowing yield enough to permit automatic adjustment to the face of the wheel. Also called "balance spring".

Brake Hose See Air Brake Hose.

Brake Jaw Jaws which may be fastened to standard rods to form brake rods.

Brake Lever A general term designating the levers used as part of the foundation brake gear. See Dead Lever, Live Lever, Floating Lever, Cylinder Lever.

Brake Lever Bracket A general term for any bracket which serves as a fulcrum for a brake lever. The bracket may be integral with, or attached to either the car underframe or the truck frame or bolster.

Brake Lever Clevis See Brake Beam Strut.

Brake Lever Connection A rod connecting two brake levers. Most commonly used to designate the rod connecting the lower ends of the truck brake levers.

Brake Lever Coupling Bar (Inside Hung Brakes) See Bottom Connecting Rod.

Brake Lever Fulcrum See Brake Beam Strut.

Brake Lever Fulcrum Tie Plate An elongated U-shaped plate, riveted at both ends to a plate which acts as a bracket. The brake lever is inserted in the opening between the two and held in place by a pin passing through all three.

Brake Lever Guide An elongated clevis the jaws of which guide the upper end of a brake lever. Further distinguished as "live lever" and "dead lever" guides, the latter provided with pins for readjustment as the brake shoes wear. Also called a "brake lever stop." See Dead Lever Guide.

Brake Lever Stop See Dead Lever Guide.

Brake Lever Strut A brake lever coupling bar or bottom rod connection.

Brake Mast See Brake Shaft.

Brake Pawl A small specially shaped iron or steel piece, pivoted to engage the teeth of a brake ratchet wheel to prevent the wheel turning backward, and thus releasing the brakes.

Brake Pawl Carrier See Brake Pawl and Brake Ratchet.

Brake Pin Any of a series of hardened steel pins of varying diameters inserted through holes in the brake lever, beams, fulcrum, rod clevises, or other points in a foundation brake system to provide for positive connection between the parts.

Brake Pin Cotter A split pin inserted in a hole at the end of a brake pin to prevent it from working loose.

Brake Pipe A term properly used, applied to describe the continuous line of brake pipe extending from the locomotive to the last car in a train, with all cars and air hoses coupled. It acts as a supply pipe for the reservoirs and also is usually the means by which the car brakes are controlled by the engineman. When a train is made up and all brake pipes on the cars are joined, the entire pipe line comprises what is commonly called the "train line".The term is often used to refer to the brake pipe on a single car.

Brake Pipe Air Strainer On older cars, a strainer inserted in the brake pipe to prevent foreign matter from entering the brake apparatus under the car.

Brake Pipe Anchor A device for holding the brake pipe in position.

Brake Pipe End Cock An appliance used on the end of brake pipe instead of an angle cock for the purpose of opening and closing brake pipe on either or both ends of a passenger car.

Brake Pipe Gradient A name used to indicate the difference between the brake pipe pressure on the front end and rear end of a train.

Brake Pipe Reduction (BPR) A reduction in air pressure in the train brake pipe. This pressure reduction causes air to flow from the air reservoir on each car or locomotive unit to the brake cylinder, thus causing the brake to apply and product a retarding force on the train.

Brake Pipe Valve A valve to maintain any given reduction in the brake pipe regardless of the brake pipe leakage.

Brake Piston Travel The movement produced by compressed air in a brake cylinder and transmitted through the brake rigging to the brake shoes on a rail vehicle.

Brake Ratchet A wheel attached to the brake shaft having teeth which the pawl engages, thus preventing the wheel and shaft from turning backward.

Brake Rigging A term commonly used instead of foundation brake gear. The term applied to the entire system of levers, rods, fulcrums, brake beams and associated connections that serves to multiply the force created by air pressure in the brake cylinder and transmit it to the brake shoes. Rigging attached to the car underframe is commonly called the "foundation brake gear," and rigging attached to or supported by the trucks, is generally termed "truck rigging."

Brake Rod Any of the rods which form the connections between brake levers and through which the braking force is transmitted.

Brake Rod Guide A bracket attached to the car underframe as a support for a brake rod. Any of the rods which form the connections between brake levers and through which the braking force is transmitted.

Brake Safety Chain Or Link A chain attached by brake safety chain eye bolts to a brake beam and to the truck. It is intended for the same purpose as a brake safety strap: to hold the brake beams in case a brake hanger breaks.

Brake Safety Strap See Brake Beam Hanger or Brake Beam Safety Support.

Brake Shaft A shaft on which a chain is wound and by which the power of a hand brake is applied to the wheels.

Brake Shaft Arm A lever fastened horizontally on top of the brake shaft for turning it and applying the brake. Sometimes used instead of a brake hand wheel.

Brake Shaft Bearing A metal sleeve through which a brake shaft passes and which it turns. Sometimes called a "brake shaft guide."

Brake Shaft Bracket A support for holding a brake shaft in place.

Brake Shaft Chain A chain connecting the brake shaft with the brake levers through the brake shaft connecting rods to the end of which it is attached. The force exerted on the shaft is transmitted by this chain.

Brake Shaft Chain Sheave A roller having a grooved surface over which a brake shaft chain passes. A sheave attached to the end sill for the chain of a horizontal brake shaft to work in.

Brake Shaft Connecting Rod A rod which is attached at one end to a brake chain and at the other to one of the levers in the foundation brake gear.

Brake Shaft Guide See Brake Shaft Bearing.

Brake Shaft Pawl See Brake Pawl.

Brake Shaft Sleeve The part of a brake shaft on which the brake chain is wound.

Brake Shaft Step A bearing which holds the power end of a brake shaft. It usually consists of a U-shaped bar of iron, the upper ends of which are fastened to the carbody with a hole in the bar which receives the end of the shaft. The brake shaft step should not be confused with a "brake step." The latter is a shelf on which the brakeman may step when applying brakes.

Brake Shaft Thimble See Brake Shaft Bearing.

Brake Shoe A block of friction material formed to fit the curved surface of the tread of a wheel, and riveted or otherwise bonded to a steel backing plate having provision for quick and positive securement to the brake head. Brakes on most conventional railway cars depend on the friction created by the brake shoe rubbing on the wheel tread during a brake application. Brake shoes can be made of cast iron or of a high friction composition material, but because of the differing friction characteristics, cast iron and composition shoes are not interchangeable.

Brake Shoe Back Steel backs are required as an AAR standard for cast shoes to reinforce and strengthen them.

Brake Shoe Clearance The distance a brake shoe stands from the wheel when brakes are released.

Brake Shoe Key A key or wedge by which a brake shoe is fastened to a brake head. It is inserted through a keyway in the face of the brake head and the lug on the brake shoe.

Brake Spool See Brake Shaft Sleeve.

Brake Spring See Release Spring.

Brake Staff See Brake Shaft.

Brake Step A platform located on the "B" end of a car below the hand brake to provide a place to stand while operating the brake.

Brake Strut (Same as Bottom Connecting Rod) A compression bar or strut between the live and dead levers of a truck with inside hung brakes. Sometimes called "brake lever coupling bar." Brake strut should not be confused with brake beam strut.

Brake System Includes all brake apparatus working harmoniously on railway vehicles, such as the air brake, electro-pneumatic brake, hand brake, and foundation brake gear.

Brake Valve The valve in the locomotive which the engineer operates the brakes. The term is also often used to refer to the control valve on a car.

Brake Valve, Automatic A device, manually operated, primarily to control the flow of air into and out of the brake pipe. This provides a means for the engineman to control the rate (service or emergency) of brake pipe reduction and the air supply (main reservoir or feed valve) into the brake pipe for charging, recharging, and releasing the brakes on both locomotive and attached cars.

Brake Valve, Electro-Pneumatic (Straight Air) A self lapping valve, separate or combined with the automatic brake valve, for controlling the flow of air to and from an electro-pneumatic master controller. This provides means for the engineman to control the application and release of electro-pneumatic (straight air) brake on locomotive and attached cars.

Brake Valve, Independent A device, manually operated, to control the application and release of the locomotive brakes regardless of other means of operation used.

Brake Valve, Pedestal A stand upon which may be mounted an automatic and independent portion, feed valve, reducing valve, equalizing piston valve portion, brake application valve, brake valve cut-out cock, etc.

Brake Valve, Straight Air A device, manually operated, to control air flow directly into and out of locomotive brake cylinders.

Brake Warning Alarm A device on diesel electric locomotives which senses excessive braking grid amperage, energizes a brake warning light and warning buzzer on the throttle stand, and on newer units, cuts out dynamic brakes.

Braking Force The pressure of the shoe against the wheel, sometimes incorrectly called brake power.

Braking Power A term used to describe the ability of a car to stop during a brake application. Braking power is determined by the total brake rigging lever ratio and the type of brake shoes on a car, and is measured as the total net brake shoe force with brake cylinder pressure at 50 pounds per square inch. There are established maximum and minimum limits on braking power, expressed as percentages of gross loaded rail weight (minimum) and empty car weight (maximum).

Braking Ratio The relation of the weight of the car or locomotive to the braking force by the weight of the car or locomotive.

Branch Pipe A pipe extending from the brake pipe to the control valve of the brake equipment.

Branch Pipe Strainer A dirt collector used in the branch pipe.

Branch Pipe Tee (Air Brake) A tee used to connect the branch pipe to the brake or train pipe.

Brass An alloy of copper and zinc. Also a term commonly used to designate a "journal bearing."

BRC See Billing Repair Card.

Break Bulk The act of unloading and distributing a portion or all of the lading in a car.

Breaking Pin A supplementary pressure retaining device used to isolate and thus protect from corrosion, the working parts of a spring loaded safety valve (commonly the Crosby Style JQ safety valve). The breaking pin is normally set to break at or near the pressure setting of the primary spring loaded portion of the valve.

Break-In-Two Separation of the train into two parts as the result of a failure in one of the draft components such as a coupler shank or coupler knuckle. Typically, the failure results from drawbar pulling forces exerted by the locomotive which exceed the strength of the coupler or knuckle.

Bridge In car construction, the term applies top a part which is supported at the ends and acts similarly to a bridge in supporting another part of the car structure.

Bridge In car construction, the term applies to a part which is supported at the ends and acts similarly to a bridge in supporting another part of the car structure.

Bridge Plate A hinged device affixed to a TOFC flatcar at the BR and AL corners used to span the gap between coupled cars to enable circus loading of trailers. Flatcars with 15" end of car cushioning require auxiliary bridge plates at the BL and AR corners to provide the additional spanning length necessary when coupled to standard draft gear cars.

Bronze An alloy composed of copper and tin, sometimes with addition of small quantities of other metals such as nickel, phosphorus and silicon.

Bronze Tools Non-sparking tools; used when fire hazards are particularly acute.

Brush A conductor serving to maintain electrical contact between the stationary and rotary elements of an electronic motor or generator.

Brush Holder A metal bracket or support attached to the frame of an electric motor or generator, but insulated from it, for holding one or more brushes.

BTU (British Thermal Units) A measure of heat.

Bubble A system under which existing emissions' sources can propose alternate means to comply with a set of emissions' limitations. Under the bubble concept, sources can control more than required at one emission point where control costs are relatively low in return for a comparable relaxation of controls at a second emission point where costs are higher.

Buff A term used to describe compressive coupler forces. The opposite of draft.

Buffer The apparatus applied to the platforms of passenger cars for the purpose of closing the space between adjoining cars. Equipped with a shock absorbing device similar to a draft gear, the buffer also helps to absorb the impacts incidental to coupling cars and, in addition, cushions and smoothes out other minor shocks and vibrations which occur during train movement.

Buffer Plate (Passenger Equipment Cars) A steel plate fastened to the end of the buffer stems, which bears against the opposing plate of the next car of the train. The vestibule face plate is bolted or riveted to and carried by the buffer plate.

Bug "O" Welding equipment used to lay multiple passes of wire on the inside of a tank car.

Builder's Plate A metal plate, commonly fastened on each side of a locomotive, giving the name of the builder, the builder's number and date of manufacture.

Build Up Increase in air pressure.

Built Date/Rebuilt Date The month and year a car is built or rebuilt. Stenciled on each side of the car.

Bulk Freight Loose freight such as coal, sand, flour and grain handled in its natural state, and not packaged, or boxed in individual units.

Bulkhead A vertical partition generally extending the full width of a car and usually used to restrain lading. The term is also used to describe the transverse partitions in a passenger car.

Bulkhead Car A flatcar equipped with bulkheads at each end, generally integral with the carbody, extending the full width of the car deck at each end, and used to provide longitudinal restraint for open top loads.

Bumping Post A post at the end of a track used to stop equipment.

Bunching Compression of slack, in a group of cars.

Burrs Jagged or rough metal edges remaining at the point of machining or cutting of a metallic substance.

Burst Pressure The value of the inlet static pressure at which a safety vent or breaking pin device functions.

Bushing A hollow cylinder made of some special purpose material and generally pressed into a hole or other opening in a dissimilar material to form a bearing for another mating part.

Business Car A term frequently applied to a car used by railway officials while traveling. Equipped with office and living accommodations for eating and sleeping.

Butt Joint A term used in railroad welding to describe a joint between two adjacent members lying approximately in the same plane. A weld connecting the two members forming a butt joint is known as a "butt weld."

Butt Weld A weld connecting to members for a butt joint. See Butt Joint.

Butterfly Valve A quarter-turn shutoff valve whose closure member consists of a generally circular disc that blocks fluid flow when perpendicular to the flow path and permits flow when rotated 90 degrees.

By-Product Material other than the principal product, that is generated as a consequence of an industrial process.

By-Pass Valve A valve which, either through manual control or automatically, will pass a gas or fluid through a direct route or an alternate route, as may become necessary in connection with the operation of the particular apparatus to which it is applied.

C

Cab The space in a locomotive "A-Unit" or "MU" car containing the operating controls and providing shelter and seats for the engine crew. See "A" Unit and Multiple Unit.

Cab Car A railway car equipped with controls for employment of an engineman or motorman. Generally used at one end of a "push-pull" train configuration.

Cab Handhold A rod or handhold on the back of the cab to assist the men in mounting or getting off a locomotive.

Cab Heater A space heater for the engineman's cab usually electric, but sometimes hot water or steam.

Cab Signal A signal located in engineman's compartment or cab, indicating a condition affecting the movement of a train or engine and used in conjunction with interlocking signals and in conjunction with or in lieu of block signals.

Cabin Car A term sometimes applied to caboose cars.

Cable (Electrical) Either a stranded conductor (single-conductor cable) or a combination of conductors insulated from one another (multiple-conductor cable).

Cable Ducts The conduits for carrying the heavier electric wires or cables.

Caboose A car usually placed at the rear of a train which provides an office and quarters for the conductor and/or trainmen while in transit, and for carrying the various supplies, tools, etc., used in freight train operations. From the caboose, the crew is also able to observe the condition of the train and initiate measures to stop the train if unfavorable conditions arise. Sometimes called "Cabin Car," "Way Car," or "Van."

Caboose, Locomotive or Passenger Car, Rebuilt A locomotive, caboose or passenger car that has undergone overhaul which has been identified by the railroad as a capital expense under (ICC) Interstate Commerce Commission accounting standards.

Caboose Valve A rotary application valve placed in the caboose so that either service or emergency applications of the train brakes on freight trains may be made from the rear end.

Caboose, Yard A caboose that is used exclusively in a single yard area.

Cafe Car A car used in passenger service having a kitchen, usually in the center; one end arranged as a dining room, the other end being fitted for other uses, such as a coach, lounge or smoking room.

Cam A rotating piece, either non-circular or eccentric, used to convert the rotary into reciprocating motion. The offsets on a camshaft are also called "the cams."

Camber A slight deviation from a straight line, either horizontal or vertical, resulting in an arc between two points on the line. Long cars have a slight positive (upward) camber built into the center and side sills to allow for deflection of the car under load.

Cam Follower The part of the valve operating mechanism which holds the cam roller and guides its direction of movement. It may be a rocker or crosshead (the latter when the motion is transmitted by push rush).

Camp Car Any on-track vehicle including outfit, camp, or bunk cars or modular homes mounted on flat cars used to house rail employees. It does not include wreck trains.

Camshaft The steel shaft on which cams are mounted to operate other devices such as valves, when the shaft is rotated.

Cannibalizing Removing parts from a vehicle to use on another vehicle without replacing the parts to the car removed from.

Cantilever A projecting beam or structure supported at only one end. Cantilever construction is commonly used to support railway signals.

Cap A layer of clay, or other highly impermeable material, installed over the top of a surface to prevent entry of rainwater an minimize production of leachate.

Capacity As applied to a freight car, the nominal load in pounds or gallons which the car is designed to carry. These figures are stenciled on the car and are identified as "CAPY." Car capacity figures are recorded in UMLER. Capacity is not to be confused with load limit, which is the maximum weight that can be loaded in a given car. See UMLER.

Capture Efficiency The fraction of all organic vapors generated by a process that are directed to an abatement or recovery device.

Car Accounting A detailed account of the movement of car equipment over a carrier's lines, which is used under the per diem rules in the settlement of debits and credits.

Car Body The main or principal part in or on which the load is placed.

Carbon Adsorber An add on control device which uses activated carbon to absorb volatile organic compounds (VOCs) from a gas stream. The VOCs are later recovered from the carbon.

Carbon Electrode An electrode used in arc welding consisting of a carbon or graphite rod with no filler metal.

Carbon Monoxide (CO_2) A colorless, odorless, nonpoisonous gas, which results from fossil fuel combustion and is normally a part of the ambient gas.

Carbon Steel Steel containing only the elements carbon, sulfur and silicon in addition to iron; the properties of which are due essentially to the percentage of carbon in the steel.

Carcinogen Any substance that can cause or contribute to the production of cancer.

Carcinogenic Cancer-producing.

Car Days An expression referring to the number of days a car owned by one railroad is on the line of another railroad.

Card Board A small wooden board secured to the outside of a freight car for tacking cards containing instructions pertaining to the load or to the car.

Car, Dedicated Service The exclusive assignment of cars to the transportation of freight between specified points under certain conditions.

Car Discharge Valve A device for manually making reductions or pulsations in the signal pipe air pressure. This actuates the signal valve which delivers air to sound the whistle.

Car Dumper A device for rapidly unloading bulk materials from open-top cars by physically turning the car upside down. Standard blocking for cradles of car dumping machines has been adopted by the AAR.

Car Float A flat-bottomed craft without power and equipped with tracks upon which cars are run from the land by means of a float bridge, to be transported across water.

Car, In Service When a car is used in connection with a railroad freight car, means each railroad freight car is subject to Railroad Freight Car Safety Standards unless the car has a "bad order" on a storage track and is empty; has a "home shop for repairs" tag or card containing prescribed information on it or; has been delivered in interchange but has not been accepted by the receiving carrier.

Car Kind Symbols Symbols used on Billing Repair Car to identify kind of car repair. See Rule 83, Field Manual of the AAR Interchange Rules.

Carline Framing members which extend across the top of a car from one side to the other and support the roof.

Car Lining Material used on the interior of a car to protect the shipment.

Carload The quantity of freight required for the application of a carload rate; the least weight at which a shipment is handled as a carload (known as C.L. Minimum Weight).

Carman A person who repairs and maintains railroad cars.

Car Mile An operating term defined as one car, moved over one mile of track.

Car Number A number given a car in conjunction with owner's initials as a means of identification.

Car Owner The company or individual car owner mark stenciled on an interchange freight car.

Car Part Code Code used to identify the area where repairs were performed on a car. See Rule 83 in the Field Manual of the AAR Interchange Rules.

Car Pooling The combining of a car equipment owned by two or more railroads or private car owners, with operational control of the cars assigned to a central agency. Pooling agreements establish the terms under which the revenue and expenses will be shared by the individual car owners.

Car Rental An amount which is paid for the use of private cars by carriers or shippers.

Car Replacer A device for getting a derailed truck back on the track. It usually consists of an inclined plane or a curved surface, by which the wheels are raised when the car is pulled, so that the flange of the outside wheel can ride upon and over the rail. Also called "rerailing frog," or simply a "rerailer."

Car Retarder A braking device built into a railway track to reduce the speed of cars being switched over a hump. Power activated shoes press against the lower portions of the wheels and slow the car to a safe coupling speed.

Carrier Iron See Coupler Carrier.

Car Seal A security device consisting of a thin metal strip with a serial number embossed on its surface, inserted through small holes in boxcar door operating hardware and permanently secured in such a manner as to make it impossible to open the door without breaking the seal. Seals can also be used on tank car dome lids and hopper car unloading outlets.

Car Service A term applicable to the general services of railroads with respect to car supply, distribution and handling; involving such matters as demurrage, interchange, per diem charges and settlements, private car line mileage statements and allowances.

Car Service Rules Rules established by agreement between railroads governing interchange of cars. See Interchange Rules.

Car Shop Repair Track One or more tracks within an area in which the testing, servicing, repair, inspection, or rebuilding of railroad rolling equipment is under the exclusive control of mechanical department personnel.

Car Type Code Four character alphanumeric code identifying a general physical description of specific car types per Exhibit D of the UMLER Specification Manual.

Casing Any housing surrounding a piece of apparatus or machinery to protect it from damage.

Casting (Noun) A general term applied to any part or component made in a mold.

Cast Iron Alloys of iron containing 1.7 percent to 4.5 percent carbon, as cast, and usually not appreciably malleable at any temperature. Railway wheels made of cast iron are prohibited.

Cast Steel Wheel A railway wheel made by pouring molten steel into a mold under well controlled conditions, followed by appropriate cleaning and heat treating. See Wrought Steel Wheel.

Catalyst Curing agent, promoter, reactor, activator, accelerator; a material used to direct a chemical reaction and frequently used to cause speed-up of final effect. The term does not refer to any specific chemical but to an effect.

Catalytic Incinerator A control device which oxidizes volatile organic compounds (VOCs) by using a catalyst to promote the combustion process. Catalytic incinerators require lower temperatures than conventional thermal incinerators, with resultant fuel and cost savings.

Categorical Exclusion A class of actions which either individually or cumulatively would not have a significant effect on the human environment and therefore would not require preparation of an environmental assessment or environmental impact statement under the National Environmental Policy Act (NEPA).

Categorical Pretreatment Standard A technology-based effluent limitation for an industrial facility which discharges into a municipal sewer system. Analogous in stringency to Best Availability Technology (BAT) for direct dischargers.

Catenary On electric railroads, the term describing the overhead conductor that is contacted by the pantograph or trolley, and its support structure that supplies electricity to propel railroad trains.

Caustic Soda Sodium hydroxide, a strong alkaline substance used as the cleaning agent in some detergents.

Cavity A recess in a valve or valve seat; it connects two or more ports to provide for the flow of air from one place to another.

CBOD5 The amount of dissolved oxygen consumed in five days from the carbonaceous portion of biological processes breaking down in an

effluent. The test methodology is the same as for BOD5, except that nitrogen demand is suppressed.

C-Clamp A temporary holding fixture used in metal fabrication work to secure components while welding, forming or machining. The device consists of a steel frame shaped roughly like a square letter "C", with an adjustable screw-operated clamp extending across the opening of the frame.

Center Anchor (on Tank Cars) An arrangement of plates which are riveted to the tank and the center sills at the center of the car. These plates anchor the tank to the frame and supplant head blocks and double anchors at the ends.

Center Band A thicker or more chemically resistant vertical paint band around the center of the tank to protect against possible commodity spills.

Center Bearing Bridge (Six-Wheel Trucks) A structure formed by the top and bottom center bearing arch bars to support the center plate block or center bearing beam and transmit the weight of the car to the bolsters on which its extremities rest.

Center Bearing A term used to describe the interface or bearing between the truck and body center plates, as distinguished from the side bearings.

Center Bolster (Six-Wheel Truck) A center bearing bridge made in a single unit of either built-up, welded or cast steel.

Center Draft Drawbar A drawbar which is connected directly with the king bolt of a truck. It is especially designed for use on very sharp curves. Sometimes termed "radial drawgear."

Center Dump Car A car which will discharge its entire load between the rails, often used in ballast service.

Center Filler The structural arrangement designed to transfer the center plate load into the carbody, located within the center sill just above each center plate.

Centering Gage A gage to locate the middle point of an axle, used in wheel-mounting operations.

Center Line In drafting, a line passing through and defining the center of the object being depicted. Center lines are used as reference lines from which measurements are taken to locate other points.

Center Pin The large steel pin which passes through the center of both the body and truck center plates and assists in keeping the two plates in proper alignment.

Center Plate See Body Center Plate and Truck Center Plate.

Center Plate Block The member supporting the center plate of a six-wheel truck.

Center Plate Centering Stud A bar connecting the centering spring for the truck on some electric locomotives with the center plate serving to communicate the spring pressure to it and thus bring the center plate back to the central position after it has been displaced for any reason.

Center Sill The center longitudinal structural member of a car underframe, which forms the backbone of the underframe and transmits most of the buffing shocks from one end of the car to the other.

Center Sill Bottom Flange That portion of the center sill bottom cover plate extending outside of the webs on either side.

Center Sill Cover Plate A heavy flat steel plate riveted or welded across the center sill webs either above (top cover plate) or below (bottom cover plate) or both, to form the sill.

Center Sill Separator A filler piece placed between the center sill webs to maintain proper alignment and provide reinforcement for the webs at crossmember locations.

Center Sill Stiffener A filling piece between the center sill webs to act as a brace for holding them rigid.

Center Sill Web One of two vertical plates forming the sides of the box section center sill. The webs are connected by a top and/or bottom cover plate and a series of separators to maintain the proper spacing.

Central Bearing A Commonwealth modification of the carbody and truck center plates whereby the load is carried on a large concentric area 2 feet in diameter which surrounds the center plate proper. The bearing surfaces are separated by a 1 in. thermoid pad. The bearing stabilizes the truck against hunting and performs the function of side bearings as well as center plates.

Centrifugal Dirt Collector A device connected in the branch pipe between the brake pipe and control valve and so constructed that due to the combined action of centrifugal force and gravity, dirt and foreign material are automatically eliminated from the air flowing through the collector chamber and by means of a plug may be removed without breaking any pipe connections whatsoever. When this device is used, the brake pipe air strainer is omitted.

Ceramic Fiber A high temperature tank insulating material generally used in combination with another insulation, such as fiberglass. The ceramic fiber is necessary in order to meet the AAR requirements for "J" cars.

Certificate of Construction The bottom portion of form AAR 4-2. After the approved Application for Approval is returned by the AAR, the builder signs the bottom portion thereby certifying that the cars will be built per the approved design. The completed form is now submitted to the BOE and the AAR. Cars cannot be placed in service until the Certificate of Construction has been submitted.

Certified Has met the requirements of federal, state, or local laws, or of company-approved programs and has been granted a certificate.The AAR Tank Car Committee has issued written authorization for a facility to fabricate, alter, convert, or perform welded repairs on tanks.

Certified Facility A shop or other facility certified by the AAR to construct or perform certain other types of operations on tank cars and/or tank car fittings.

CFM A disc brake system utilizing brake shoe frame suspension on a separate unit.

Chafing Plate A removable metal plate to resist wear, used on places where wear concentrates.

Changeover Valve A valve used with double-capacity brakes to enable changing from "empty" to "load" brake.

Channel A commercial rolled steel bar shaped like a trough or channel. Channel sections are extensively used in railway car construction, particularly in the underframe.

Characteristic Any one of the four categories used in defining hazardous waste: ignitability, corrosivity, reactivity, and toxicity.

Charging (Air Brake) A term used to describe the process of supplying the initial volume of compressed air to the air brake system on a car or a train. A car is said to be fully charged when the brake pipe reaches and holds the pressure established by the feed or regulating valve. Care must be taken to allow for brake pipe taper.

Charging Change-Over A function of a locomotive operating valve for controlling the charging of the reservoirs or pressure chamber to make overcharge less likely and to use less air at critical time when it may be needed back in train for release, charge, and recharge on long freight trains.

Charging Ports Used instead of feed grooves for the flow of air from one side of a piston to the other. They are protected by filters to prevent infiltration of and stoppage by foreign matter.

Charging Receptacle An electric fitting or connection device allowing for a plug-in connection to charge batteries on cars or locomotives.

Charpy Tested Steel Steel, intended for low temperature service, that has been tested to verify compliance with a specific low temperature strength standard.

Check Valve Generally defined as a valve which permits flow in one direction only.

Cheek-Disk Brake Features disks that are attached directly to the wheel-plates of the driver wheels. Brake calipers wrap around the wheel rim to apply brake shoes to the disk faces when brakes apply. Each driving wheel becomes the heat sink that dissipates heat generated during braking.

Cheek Plate A casting which takes the place of draft lugs when horizontal coupler yokes and two key draft gears are used. See Draft Lug.

Chemical Oxygen Demand (COD) A measure of the oxygen required to oxidize all compounds in water, both organic and inorganic.

Chemical Treatment Any one of a variety of technologies that use chemicals or a variety of chemical processes to treat waste.

Chemistry Laboratory The chemical composition of each heat of steel is checked by a spectrometer.

Chemtrec Chemical Transportation Emergency Center Chlorinated Solvent. An organic solvent containing chlorine atoms, e.g., methylene chloride and 1,1,1-trichloromethane, which are used in aerosol spray containers and in traffic paint.

Choke A reduced-size opening in a passage or tube to restrict the flow of air.

Choke Fitting (Air Brake) A special pipe fitting with a restricted air passage to control the flow of air. Chokes are used in car and locomotive brake control valves and in various other parts of air brake equipment.

Choke Plug A plug made to press or screw into a passage pipe fitting or tube, with a hole in it of a reduced capacity in order to restrict the flow of air.

Chord (Car Construction) The long horizontal members at the top and bottom of a car side or end.

Chronic Reference Dose (RfD) An estimate (with uncertainty spanning perhaps an order of magnitude or greater) of a lifetime daily exposure level for the human population, including sensitive subpopulations, that is likely to be without an appreciable risk of deleterious effects. Chronic RfDs are specifically developed to be protective for long term exposure to a compound (7 years to lifetime).

Chronic Toxicity The capacity of a substance to cause long-term poisonous human health effects. See Acute Toxicity.

Cineston Controller Brake Valve A registered trademark name for a combined controller and brake valve used on subway brake equipment.

Circuit (Electrical) A complete path of an electric current including the generating device.

Circuit, Acknowledgment A circuit consisting of wire or other conducting material installed between the track rails at each signal in territory where an automatic train top system or cab signal system of the continuous inductive type with 2-indication cab signals is in service to enforce acknowledgment by the engineman at each signal displaying an aspect requiring a stop.

Circuit Breaker A device for automatically opening an electric circuit when the current exceeds a predetermined amount.

Circuit, Cut-in A roadway at the entrance to automatic train stop, train control or cab signal territory by means of which locomotive equipment of the continuous inductive type is actuated so as to be in operative condition.

Circus Loading A term used to describe an older method of loading highway trailers on TOFC (piggyback) flatcars, whereby a tractor backs the trailer up a ramp placed at one end of a cut of cars, and along the decks of the cars to the point of securement. Circus loading requires bridge plates at each end of all cars to enable the trailer and tractor to pass from car to car. See Side Loading, Overhead Loading.

Clasp Brake A truck brake rigging arrangement using two brake shoes on each wheel instead of the usual one. The shoes are on either side of the wheel and act in opposite directions like the jaws of a vice. Clasp brakes are used on locomotives and some iron ore cars, and in other applications where braking requirements are unusually heavy.

Class I Railroad A railroad whose operating revenues are more than $50 million.

Class II Railroad A railroad whose operating revenues are between $10 and $50 million.

Classification Light A light on a locomotive or car used to designate the class of the train.

Classification of Cars Designating letters and descriptive definitions adopted by the AAR to cover various types of freight cars.

Classification Yard A rail yard consisting of a number of usually parallel tracks, used for making-up trains.

Claw Jack A jack having a step or projection at the bottom of the movable column, used when a bearing close to the ground is required.

Cleaning Removal of foreign matter from the surfaces exposed to the commodity by chemical, thermal, or mechanical means.

Cleanup Actions taken to deal with a release or threat of release of a hazardous substance that could affect human and/or the environment. The term "cleanup" is sometimes used interchangeably with the terms remedial action, removal, response action, or corrective action.

Clearance Car A special car equipped with a means of measuring and recording the maximum clearance through tunnels and past other structures along the right of way of the railroad. Data from the clearance car is used to determine the maximum height and width of equipment that can operate over individual segments of the railroad.

Clearance Diagram An outline or cross section drawing representing the maximum limiting dimensions to which rail equipment can be built. Specific limiting dimensions have been established and are shown on standard clearance diagrams known as "plates."

Clearance Volume (Internal Combustion Engine) The volume of air space remaining in the cylinder when the piston has reached the end of it's inward or compression stroke.

Clearance A general term meaning space between two objects.

Clevis A stirrup-shaped metal strap used in conjunction with a pin for attachment to the apparatus of which it is a part. Clevises are used extensively in brake rigging to connect the rods and levers.

Clip In general, a device permanently attached to one part, whose function it is to hold another part in place, but with provision for easy removal.

Closed Car Any roofed or permanently covered railway freight car, other than a tank car, used by a rail carrier for the transportation of freight by rail, as distinguished from "open top car."

Closed Return Bend A short cast tube made in a U-shape, for uniting the ends of two parallel pipes. It differs from an open return bend in having the two branches close to each other.

Closed-Loop Recycling Reclaiming or reusing waste water for nonpotable purposes in an enclosed process.

Closing Pressure The pressure, measured at the valve inlet, at which the valve closes, flow is substantially shut off, and there is no measurable lift.

Club Car A term applied to a special type of parlor or lounge car, often arranged in two or more compartments and generally having movable instead of fixed seats. Where provided with a bar, such a car is also called a "tavern" or "tap room car."

Clutch A device installed in a rotating drive system to allow for partial or complete disengagement of the driving mechanism to meet varying demands of service.

Coach A passenger carrying car, usually with a center aisle and two rows of twin seats.

Coagulation A clumping of particles in waste water to settle out impurities. It is often induced by chemicals such as lime, alum, and iron salts.

Coal Car Usually a hopper or gondola car, for carrying coal.

Cobestos Gasket A gasket for steam compressors, made of a center of asbestos with layers of copper on both sides crimped around the edges with openings for passage of steam, otherwise making a steam-tight fit between the cylinder and head and between the cylinders and center casting.

Cock A manually operated device used in pipes, passages, tubes, etc., to either permit or prevent the flow of air from one place to another.

Code (Rules) A general term used to describe any set of regulations dealing with some specific subject, such as interchange of freight cars or per diem.

Code of Federal Regulations Regulations issued by various branches and agencies of the federal government under the authority of statutes. Title 49 CFR pertains to transportation.

Coefficient of Friction The measure of friction in percentage, between the brake shoe and the wheel.

Coefficient of Haze (COH) A measurement of visibility interference in the atmosphere.

COFC An acronym for "Container On Flat Car." A type of rail-freight service involving the movement of closed containers on special flat cars equipped for rapid and positive securement of the containers using special pedestals or bolsters.

Coil Gap (Tank Car Heaters) An undesirable condition caused by the spacing of heater coils too far apart to produce optimum thermal efficiency.

Coil Overlap (Tank Car Heaters) An undesirable condition, opposite of coil gap, in which the coils are spaced closer than necessary, thus creating an inefficient pattern of heating.

Coil Spring A spring made by winding round wire or rods in a helical pattern around a circular core. Coil springs are used extensively in rail car suspension systems.

Coiled A general term that refers to a tank car that is equipped with some type of interior or exterior heater coil system.

Coils (Tank Cars) A general term used to describe various types of heater pipe systems for tank cars. See Heater Pipes.

Coke Car A car of large cubic capacity for carrying coke; usually a modified hopper car with doors which discharge the load to one or both sides of the track.

Coke Rack A slatted frame or box, applied above the sides and ends of gondola or hopper cars, to increase the cubic capacity for the purpose of carrying coke or other freight, the bulk of which is large relative to its weight.

Cold Shot Small globules of iron, resembling ordinary gun shot, which are found in castings. Cold shot defects are caused during the pouring operations by spatterings of iron sticking to portions of the mold where they cooled before being surrounded by the main mass of molten metal.

Cold Shut A casting defect that occurs during casting of molten metal which may result from splashing, surging, or interrupted pouring. Cold shuts may be attributed to any factor that will prevent a perfect union where two surfaces meet and should fuse and blend.

Collar A circular ring or flange usually at the end of a round shaft, and used for retaining some other part on the shaft.

Collecting System An extensive system collects smoke and dust as a protective measure for both plant employees and the environment.

Column Wear Plate The replaceable steel wear plates mounted to the truck side frames that transit frictional forces caused by vertical movement between truck bolster and side frame.

Combination Device A breaking pin or frangible disc in combination with a safety relief valve in which the breaking pin is located between the tank and safety relief valve.

Combination Support And Safety Device Consists of combination of rigid safety guard and a flexible brake beam support.

Combined Strainer and Nonreturn Check A device having a hair strainer in the same casting with a flat check valve. Springs of different value are used in this check valve so that the device is used as a means of reducing the supplied pressure. A common example is the dead engine fixture where a 20 pounds spring is used, or a signal fixture where a 3 pounds spring is used. A choke fitting is used in most bodies at the delivery end.

Combustible Liquid Any liquid having a flash point at or above 100°F (37.8°C).

Combustion Chamber (Internal Combustion Engines) The clearance volume above the piston at the upper end of its travel. In a diesel engine the fuel is injected into this volume.

Combustion Product Substance produced during the burning or oxidation of a material.

Combustion Burning, or rapid oxidation, accompanied by release of energy in the form of heat and light. A basic cause of air pollution.

Comment Period Time provided for the public to review and comment on a proposed EPA action or rule making after it is published in the Federal Register.

Commodity Stenciling Lettering placed on the sides of any rail car describing any special ladings for which the car has been made suitable to transport.

Commodity A general term used to describe the contents of a car. Other terms such as "lading," "product" or "grade" means the same thing and are often used interchangeably.

Communicating Signal System A term sometimes used for air signal equipment, which is an arrangement of devices used on passenger trains so that trainmen may signal enginemen.

Commutating Pole Motor A railway motor in which four auxiliary coils and pole pieces called commutating poles are mounted between the four main field poles. The windings of these poles are connected in series with each other and with the armature. The commutation is improved and the poles perform their functions equally well regardless of the direction in which the motor is run. See Armature.

Commutator A cylindrical ring or disk assembly of conducting members, individually insulated in a supporting structure with an exposed surface for contact with current collecting brushes.

Commuter Train A short haul passenger train operating on track which is part of the general railroad system of transportation, within an urban, suburban or metropolitan area. It includes a passenger train provided by an instrumentality of a state or political subdivision thereof.

Company Car In general sense, a freight car owned by the carrier over whose line it is being operated as opposed to a "foreign car." Sometimes called a "system car."

Company Material Material transported by a particular railroad such as rail, crossties, ballast, fuel oil, etc., used in connection with its operations.

Compartment Tank Car A tank car in which the tank is divided into several sections for the purpose of carrying different commodities or smaller shipments.

Compartment In passenger train service, a subdivision of a parlor or sleeping car running only partially across, allowing room for a corridor at the side. Sometimes called "stateroom."

Compensate Make up for, or take place of.

Compensating Chamber A space in the load-compensating brake cylinder into which air is admitted by the compensating valve to oppose the brake cylinder pressure on the opposite side of its piston. No air is admitted when car is fully loaded, and more air is measured into compensating chamber proportionately as it has lighter load so that when car is empty full pressure is admitted.

Compensating Ports Needed on double-end locomotive equipment. Used in distributing valves to connect brake pipe to distributing valve release pipe in service application; acts as quick service feature and prevents drop in application cylinder pressure when brake valve for supplying air to application cylinder and chamber to provide air for the extra volume of the long application cylinder pipe on the double-end locomotive equipment.

Compensating Valve A mechanism used with the load-compensating brake to weigh the load and measure air to the compensating chamber of the brake cylinder in proportion to the load of the car.

Compliance Coating A coating whose volatile organic compound content does not exceed that allowed by regulations.

Compliance Schedule A negotiated agreement between a pollution source and a government agency that specifies dates and procedures by which a source will reduce emissions and, thereby, comply with a regulation.

Composite Construction (Freight Cars) A car with a combination of steel and wood superstructure.

Compressed Air Air compressed into a retaining chamber so that it exerts outward pressure.

Compression Ignition Ignition of a fuel charge by the heat of the air in a cylinder generated by compression of the air.

Compression Member Any part of a structure or truss that experiences compressive forces when serving its intended purpose.

Compression of a Train The bunching of cars in a train caused by run-in of slack from the rear end.

Compression Ratio (Internal Combustion Engines) The ratio of the final pressure reached during compression to the pressure at the beginning of compression.

Compression Rings Piston rings placed in the upper section of the piston barrel to seal against loss of compression and gas blowing.

Compression A general term used to describe forces which have a tendency to squeeze together.

Compressive Strength The maximum compressive stress which a material is capable of sustaining without permanent deformation.

Compressor (Commonly called "Air Pump") A device so made as to cause a partial vacuum for intake of air, that forces the air into smaller space, increasing its pressure.

Compressor Cradle (Air Brake) A steel frame for supporting a motor-driven air compressor. The cradle is secured by means of brackets having pockets in which are rubber cushions so arranged as to prevent vibrations of the compressor from being communicated to the body and to allow its removal quickly and easily.

Compressor Governor (Pump Governor) A device to automatically stop and start the compressor and regulate main reservoir pressure. See Pump Governor.

Compressor Manifold A hollow casting connecting the intake valves to the atmosphere, through a filter.

Compressor Synchronizing System An arrangement of trainlined wires, relays, and pressure switches designed to equalize the load on a series of air compressors by causing all of them to "load" and "unload" simultaneously.

Compressor, Belt Driven One driven by a belt connected to a power source.

Compressor, Clutch Driven (or Mechanically Driven) A compressor which uses a clutch for drive.

Compressor, Compound A two-stage compressor having high- and low-pressure cylinders.

Compressor, Cross-Compound Driven by steam which is compounded and using two-stage air pressure build-up having cylinders parallel.

Compressor, Double-Acting Compresses air in both ends of cylinders on both sides of piston.

Compressor, Duplex Type One having two cylinders, single-acting, single-stage.

Compressor, Hand Operated Originally a pantograph pump.

Compressor, Motor Driven One using a motor for power with pistons connected to a drive shaft.

Compressor, Quadruplex Single-stage, single-acting; two cylinders vertical, two cylinders horizontal.

Compressor, Radial Radial cylinder arrangement.

Compressor, Single-Acting Compresses air in only one end of cylinder.

Compressor, Single-Stage Compresses air only once.

Compressor, Steam-Driven Uses steam for power.

Compressor, Tandem Compound Cylinders are end-to-end.

Compulsory Arbitration Arbitration that is required by law.

Conciliation See Mediation.

Condemnable Any condition warranting inspection, repair, or testing of a freight car specified in any section of the interchange rules.

Condenser (Air Brake) A device used for removing moisture from compressed air by cooling the air.

Condenser (Capacitor) Electric device consisting of a coil of wire which is charged when electric current is passed through the coil and momentarily discharges current when the circuit flow through the coil is reduced or interrupted. Used with electro-pneumatic brakes to suppress arcing and for sensitive relay valves.

Condition Codes Numerical code used on Billing Repair Cards to indicate grade of material applied or repairs performed.

Conditionally Approved The status of a practice or procedure, an item of equipment, a design, product, device or facility which has been reviewed by the AAR Mechanical Division and found to meet the applicable requirements for use in interchange service with restrictions imposed as to quantity, period of service, type of application, test conditions, or other limitations as stated in the applicable Standard, Specification or Alternate Standard. This term is used in lieu of former status "Approved for Test." (AAR)

Conductivity The relative facility with which a conductor transmits electric current. The term resistance is applied to the inverse or reciprocal of this property. Also called "conductance."

Conductor (Electrical) Electrical wire or cable that carries electric current.

Conductor's Valve An air brake valve that can be operated from a car vestibule on the caboose. Term changed to "emergency-brake valve." A device located in passenger cars, locomotives, and cabooses, by means of which the brakes can be applied.

Conformity The ongoing process that ensures the planning for highway and transit systems, as a whole and over the long term, is consistent with the state air quality plans for attaining and maintaining health-based air quality standards; conformity is determined by metropolitan planning organizations (MPOs) and the US Department of Transportation (US DOT), and is based on whether transportation plans and programs meet the provisions of a State Implementation Plan.

Congestion Mitigation and Air Quality (CMAQ) Federal funds available for either transit or highway projects which contribute significantly to reducing automobile emissions which cause air pollution.

Conical Jacket Heads Regarding tank cars; refers to the general shape of a jacket head that was fabricated by means other than pressing.

Connecting Rod The rod which connects the crank and the piston.

Consent Decree A legal document, approved by a judge, that formalizes an agreement reached between EPA and potentially responsible parties (PRPs) through which PRPs will conduct all or part of a cleanup action at a Superfund site; cease or correct actions or processes that are polluting the environment; or otherwise comply with regulations where the PRP's failure to comply caused EPA to initiate regulatory enforcement actions. The consent decree describes the actions PRP's will take and may be subject to a public comment period.

Conservation Avoiding waste of, and renewing when possible, human and natural resources. The protection, improvement, and use of natural resources according to principles that will assure their highest economic or social benefits.

Consist See Train Consist.

Constant Contact Side Bearing A side bearing designed to eliminate the normal clearance gap between it and the body side bearing.

Contact Rate Amount of medium (e.g., ground water, soil) contracted per unit time or event (e.g., liters of water ingested per day).

Contact Stress Stress is force per unit area. Hence, the force (weight) exerted by the wheel upon the small area where the wheel rests upon the rail.

Contactor An air or electrically-operated switch used to make or brake an electrical circuit.

Container Bolster A container securement device generally used on raised center sill cars. Container bolsters are arranged to mount transversely on a flatcar, and support the container at each end.

Container Car A car equipped to transport one or more removable containers.

Container Pedestal A securement device mounted on the deck of a flat car arranged to support a container at its corner fitting. Some COFC cars are equipped with adjustable pedestals for handling containers of various lengths.

Container An independent structural unit, either open or fully enclosed, designed for the intermodal transport of commodities. A large percentage of intermodal containers are designed with standard corner fittings for positive securement to highway trailers, rail cars or ocean-going vessels, thereby facilitating interchange between carriers in international trade.

Containerization A term used to describe the hauling of freight in containers without wheels.

Contaminant Any physical, chemical, biological, or radiological substance or matter that has an adverse affect on air, water, or soil.

Contingency Plan A document setting out an organized, planned, and coordinated course of action to be followed in case of a fire, explosion, or other accident that releases toxic chemical, hazardous wastes, or radioactive materials which threaten human health or the environment.

Continuous Control A type of locomotive control in which the locomotive apparatus is constantly in contact with the track elements, and is immediately responsive to a change of conditions in the controlling section which affects train movement.

Continuous Tractive Effort That tractive effort that can be sustained indefinitely by a locomotive without overheating any part of the locomotive traction equipment.

Contract Authority A federal budgetary term that refers to a form of budget authority permitting obligations to be incurred in advance of appropriations. Advance obligations, however, have been limited by the appropriations committees with obligation limitations.

Contract Labs Laboratories under contract to EPA, which analyze samples taken from wastes, soil, air, and water or carry out research projects.

Contract Shop A repair facility designated by car owner to perform repairs to interchange freight cars.

Contraflow Lane Reserved lane for buses on which the direction of bus traffic is opposite to the flow of traffic on the other lanes.

Control Circuit A low-voltage circuit which operates the contactors in a high voltage power circuit through relays and interlocks.

Control Stand The upright column upon which the throttle control, reverser handle, transition lever, and dynamic braking control are mounted within convenient reach of the engineer on a locomotive. The air gages and some control switches are also included on the control stand.

Control Technique Guidelines (CTG) A series of EPA documents designed to assist in defining reasonable available control technology (RACT) for major sources of volatile organic compounds (VOCs).

Control Unit In multiple unit locomotive consists, the locomotive unit from which the engineer operates the consist. Also called the "lead unit."

Control Valve The part of the freight car air brake equipment on each car that controls the charging, application, and release of the brakes on the car. Several common types of control valves in use on modern freight cars are the AB, ABD, ABDW, ABDX, ABDX-L, DB-60 and DB-60L valves.

Controlair Valve The registered trade mark name for a device for controlling air flow through pressure adjustment, dependent upon positioning of the operating mechanism. The air pressure is maintained against leakage into or out of the delivery line.

Controlled Emergency A function of brakes for long freight trains whereby the building up of brake cylinder pressure during emergency application is such as to avoid intolerable shocks through train slack action.

Controller The equipment at the engineman's position used to control the operation of a locomotive or MU car.

Conventional Brakes A brake system whose brake cylinder is mounted on the carbody rather than on the trucks.

Conventional Units Unit of measurement from the English system (customary in the US) rather than the metric system.

Conventual Pollutants Statutorily listed pollutants which are understood well by scientists. These may be in the form of organic waste, sediment, acid, bacteria and viruses, nutrients, oil and grease, or heat.

Conversion A change in tank or fittings that changes the DOT or AAR specification. Sometimes used to refer to any physical change to a tank car.

Converter, Rotary An electric machine having a commutator at one end and slip rings at the other end of the armature. It is used for conversion of alternating to direct current.

Convertible Car A car so built that it may be converted without reconstruction from one type to another, as center-dump gondola (effective as a ballast car) to side-dump gondola (used as a car for grading).

Conveyor Car A freight car equipped with motors for moving freight under special conditions, as on a coal wharf.

Cooling Coil A coil or length of pipe carrying a refrigerant and having sufficient radiating surface to cool the surrounding fluid to a desired temperature. In air conditioning systems, the cooling coil is called the "evaporator."

Cooling Kiln Wheels are cooled from 2,000 degrees F to 1,000 degrees F to reduce stress formation.

Cooling Water System The entire system of pumps, pipes, radiators, fans, and other apparatus installed on an internal combustion engine to cool the engine.

Cooling Water The fluid which circulates through the jacket space of cylinders and cylinder heads to prevent excessive heating of the castings.

Corner Brace A diagonal member in the underframe between the end sill and transverse floor member or bolster. See End Sill Diagonal Brace.

Corner Casting On freight cars, a heavy metal casting fitting on either the lower or upper outside corners of cars at the three-way joint formed by the two horizontal members and the vertical corner post for the purpose of reinforcing the corner joint. On containers, a standard casting that fits over all (8) corners of the unit and has holes for engaging standard securement locks on rail cars, trucks and ships.

Corner Post The vertical member which forms the corner of the frame of a carbody.

Correct Repairs Material and repairs specified in Section B of any interchange rule.

Corridor A broad geographical band that follows a general directional flow connecting major sources of trips that may contain a number of streets, highways and transit route alignments.

Corrosion The deterioration or eating away of the surface of metal through chemical action.

Cost Factors Indices used to adjust the original cost of a freight car for annual price fluctuations.

Cost of Reproduction, New As applied to Interstate Commerce Commission (ICC) valuation, the estimated cost of reproducing the property of a carrier, based on the unit prices or price trends of a specific period.

Cost Recovery A legal process by which potentially responsible parties who contributed to contamination at a Superfund site can be required to reimburse the Trust Fund for money spent during any cleanup actions by the federal government.

Cost-Effective Alternative An alternative control or corrective method identified after analysis as being the best available in terms of reliability, permanence, and economic considerations. Although costs are an important consideration, when regulatory and compliance methods are considered, such analysis does not require EPA to choose the least expensive alternative.

Cost-of-Living Allowance (COLA) An increase or decrease in employees' wages or salaries made on the basis of changes in agreed-upon economic indices, usually the Consumer Price Index.

COT&S An acronym for the periodic servicing of brake system components and indicating "Clean, Oil, Test and Stencil."

Cotter Pin A slit pin inserted in a small hole and expanded to prevent its backing out. Used in place of a nut or to prevent a nut from becoming loose. See Brake Pin Cotter.

Counter Balances Metal applied to the crank checks opposite to the crank pins on an engine crankshaft to balance the reciprocating forces produced by the piston and connection rod.

Counter Billing Authority (CBA) A document that issues authorization to collect an overcharge (similar to a credit memo) or to deduct (offset) an overcharge from a bill.

Counterbore An enlargement, for a certain portion of its depth, of a smaller hole bored in any piece of material. The counterbore is made of sufficient depth to allow the head or the nut to come below the surface of the piece.

Countersink To ream a hole to receive the conical head of a rivet, bolt, or screw so that the head will not project beyond the surface of the part connected.

Counterweight Any weight applied to an apparatus for the purpose of balancing usually heavy forces that would otherwise hinder convenient operation of the apparatus.

Coupler A device located at both ends of all cars and locomotives in a standard location to provide a means for connecting a locomotive units together, for coupling cars together or for coupling cars together to make up a train. The standard AAR coupler uses a pivoting knuckle and an internal mechanism that automatically locks when the knuckle is pushed closed, either manually or by a mating coupler. A manual operation is necessary to uncouple two cars whose couplers are locked together. See E Coupler, and Shelf Coupler interchange rule.

Coupler Couplet (of Springs) Two elliptic springs, placed side by side, to act as one spring.

Coupler Butt The extreme rear portion of the shank of a coupler.

Coupler Carrier A casting or weldment, usually integral with the car end sill, serving to support the weight of the coupler while allowing it to pivot about its yoke connecting pin. Some coupler carriers are spring-mounted to allow for vertical movement of the shank when coupler head design restricts relative movement between coupler knuckles.

Coupler Centering Device An arrangement for maintaining the coupler nominally in the center line of draft but allowing it to move to either side when a car is rounding a curve while coupled to another car.

Coupler Contour The shape or configuration of a coupler as it would appear traced on a horizontal plane passed through the coupler head and knuckle at the center line. The contour line would outline the shape of the knuckle, the inside face of the head, and the guard arm.

Coupler Guard Arm That portion of the coupler head opposite the knuckle. The guard arm guides a mating coupler into position during a coupling operation and forms one side of the pocket into which the opposing coupler knuckle fits while two cars are coupled.

Coupler Head That portion of the coupler that houses the locking mechanism. A pivot mount for the coupler knuckle is on one side of the head and the guard arm is on the opposite side.

Coupler Height The vertical distance above the rail to the center of the coupler knuckle measured with the coupler properly installed, and the car on level, tangent track. Standard nominal coupler height for new cars (empty car) is 34½".

Coupler Horn The projecting lug cast on top of the coupler head which bears on the striker plate when the draft gear is fully compressed.

Coupler Knuckle See Knuckle.

Coupler Lock Lifter That part of the mechanism inside the coupler head which is activated by the uncoupling rod and lifts the lock so that the knuckle can open. Sometimes called the "lock lift."

Coupler Lock Set A device, by which the knuckle lock when lifted is held in a raised position until the knuckle is opened at which time it allows the lock to drop back into position for automatic coupling when the cars are brought together.

Coupler Lock One of the internal components of a coupler. The lock drops into position by gravity when the knuckle closes and prevents reopening of the knuckle until the uncoupling mechanism is activated.

Coupler Release Rigging See Uncoupling Lever or rod.

Coupler Shank That part of a coupler behind the head and containing either a slot or a pinhole at the rear portion for connection to the yoke and draft system.

Coupler Yoke A cast steel component of the draft system that functions as the connecting link between the coupler and the draft gear.

Cover Plate In steel construction, a general term referring to any flat plate connected to two other structural numbers generally at a 90 degree angle forming a "cover" over the two top members. In car construction, many underframe members are box sections with top and bottom cover plates.

Covered Gondola A gondola car which has been equipped with some form of removable cover which can be placed over the lading to protect it from weather exposure in transit.

Covered Hopper Car A hopper car with a permanent roof, roof hatches and bottom openings for unloading. Used for carrying cement, grain or other bulk commodities.

Crabs or Tongs (Pile Driver and Wreck Crane) A pair of loose bent steel bars fastened at the top with a ring and intended to firmly clamp to the underside of the rail head when an upward pull is applied to the ring. They are used to anchor a pile driver car, steam shovel or wreck crane to the rails and prevent them from overturning when a heavy load is being lifted. A jack screw is used in connection with tongs to raise the body of the car and keep the tongs under strain. Also called "rail clips" or "trail clamps."

Crack Separation of material extending partially but not necessarily completely through the cross section of the plate.

Crank That part of the crankshaft to which the connecting rod is attached.

Crankcase The lower part of the engine structure surrounding the working parts.

Crankcase Explosion An explosion caused by the ignition of an explosive mixture of fuel vapor and air in the crankcase of a diesel engine. The explosive mixture may result from incomplete atomization and partial combustion of the fuel injected into the combustion chamber. A spark from an overheated bearing or from interference between metal parts may cause the ignition.

Crankshaft Bearing A bearing placed in the locomotive engine frame or bedplate that carries the crankshaft in its proper location.

Crankpin That part of the crank to which the connecting rod is connected in an internal combustion engine.

Criteria Descriptive factors taken into account by EPA in setting standards for various pollutants. These factors are used to determine limits on allowable concentration levels and to limit the number of violations per year. When issued by EPA, the criteria provide guidance to the states on how to establish their standards.

Criteria Pollutants The 1970 amendments to the Clean Air Act required EPA to set National Ambient Air Quality Standards for certain pollutants known to be hazardous to human health. EPA has identified and set standards to protect human health and welfare for six pollutants: ozone, carbon monoxide, total suspended particulates, sulfur dioxide, lead, and nitrogen oxide. The term, "criteria pollutants" derives from the requirement that EPA must describe the characteristics and potential health and welfare effects of these pollutants. It is on the basis of these criteria that standards are set or revised.

Critical Speed (of a Car) That speed at which the frequency of lateral rocking of a freight car on its center plate is reinforced by rail joints in the track, thus increasing the magnitude of the rocking and sometimes causing a derailment.

Cross Bar A bar with locking devices at each end that fit and lock to belt rails in DF boxcars to provide longitudinal restraint for lading. Cross bars are sometimes called "cross members."

Cross Section A vertical section of any object, depicting the object as it would be seen if projected on a vertical plane in which it passes through.

Cross Tie Intermediate transverse structural members of a freight car underframe extending from the center sill to the side sill. See Crossbearer.

Crossbearer (Car Construction) A transverse member of the underframe, serving to connect the side sills to the center sill. Crossbearers generally extend completely across the car through a filler in the center sill, while cross ties are lighter members connecting the center and side sills together.

Crosshead (Air Brake Cylinder) A forked casting or forging attached to the end of the cylinder piston rod to which the brake levers are connected.

Crossover Platform A drop step located on the engine front and rear permitting movement of personnel between units.

Crosstown Non-radial bus or rail service which does not enter the Central Business District (CBD).

Crown That portion of a roller bearing adapter casting that bears on the pedestal roof of a truck side frame.

Cubic Capacity The number of cubic feet of lading that can be loaded into a car.

Cubic Feet per Minute (CFM) A measure of the volume of substance flowing through air within a fixed period of time. With regard to indoor

air, refers to amount of air, in cubic feet, that is exchanged in a minute's time, or an air exchange rate.

Cupola A small cabin on the roof of a caboose to afford a means of lookout for the train crew.

Curve (of a Railroad Line) In the United States, it is customary to express track curvature in degrees noted by the deflection from the tangent measured at stations 100 feet apart. In other words, the number of degrees of central angle subtended by a chord of 100 feet represents the "degree curve." One degree of curvature is equal to a radius of 5,750 feet.

Curve Drag Drag resulting from locomotive and/or railcar trucks rolling in curved track. Its value varies from nearly zero for radial, steering or self-steering trucks, to 0.8 lbs./ton for vehicles having rigid trucks. See also Drag.

Cushioned Underframe A term generally used to describe a freight car designed with a center sill arranged so that a hydraulically cushioned inner sill, free to slide with respect to a rigid outer sill, absorbs a major portion of the end impact loads experienced in switching. Not to be confused with end-of-car cushioning devices, which are independent units installed in the draft gear pockets behind each coupler.

Cushioning A term referring to the energy-absorbing capabilities of a car underframe or draft system. Although standard draft gears do have energy-absorbing capabilities, the term "cushioning" or "hydraulic cushioning" is generally understood to mean systems with a minimum travel of ten inches.

Cut (of Cars) A group of cars coupled together that are to be moved as a unit (generally, either to be added or dropped from a train).

Cut-Off Valve Name sometimes used for cut-out valve; also short name for main reservoir cut-off valve and pilot cut-off valve.

Cut-Out Valve A name given to a variety of valves used for the purpose, as indicated by the name, of cutting out certain operations.

Cutout (Electrical) An electrical device to interrupt the flow of current through any particular apparatus or instrument, either automatically or by hand.

Cut-out Cock A valve in the branch pipe of an air brake system that can be closed to nullify the brake on an individual car without affecting the brakes on adjacent cars. On modern freight cars, the cutout cock is combined with a dirt collector, or strainer, to keep foreign matter from entering the control valve, and the assembly is known as a "combination dirt collector and cutout cock." In general terms, a cutout cock is any valve inserted in a piping system that allows flow to be shut off to a particular branch of that system.

Cutout (Railcar) Generally refers to an access opening in a tank or jacket which will later be either permanently covered or closed by a removable closure.

Cutting Torch A tool used in oxygen cutting operations for controlling and directing the gases used for preheating, and the oxygen used for cutting the metal.

Cycle In general terms, a complete series of operations which occur in a repetitious manner. A complete cycle has occurred when the last operation has been completed and the first operation is about to begin again.

Cylinder Head The closure over the end of a cylinder, generally secured with bolts or studs. The pressure head is on the end of the cylinder under pressure, while the non-pressure head closes the end where no pressure exists.

Cylinder Lever Guide A U-shaped bar or bracket fastened to the car underframe that supports and guides the cylinder lever during operation of the air brakes.

Cylinder Lever The brake lever in the body or foundation rigging that transmits the braking force from the brake cylinder to the floating lever.

Cylinder Liner (Engine) A tube placed in the cylinder block that takes the wear of the piston and forms the cylinder itself.

Cylinder Support A bracket attached to the car underframe to which the brake cylinder is attached.

Cylinder Any enclosed chamber, generally of circular cross section fitted with a piston for transforming the energy of a compressed fluid into linear motion for some useful purpose. See Brake Cylinder.

D

Dampener Any material or device used to reduce vibration.

Data Exchange System The AAR's system of collecting, sorting, analyzing and distributing freight car repair information to participating railroads and car owners.

DB-60 Brake Valve An AAR approved control valve, of a different design, which is the equivalent of the ABDX control valve, and which can be used in all applications calling for the use of AB, ABD, ABDW, ABDX, and ABDX-R control valves.

DB-60L Brake Valve An AAR approved control valve, of a different design, which is the equivalent of the ABDX-L control valve, and which can be used in all applications calling for the use of ABDX-L control valves.

DC Traction Motor A series wound type of electric motor powered by direct current.

Dead Cylinder Lever That part of the foundation brake gear connected to the live cylinder lever by a tie rod and to the live truck lever by the top rod.

Dead-End Power A system of furnishing electric power for a complete railway train from a single generation plant either in the locomotive or on a special power car.

Dead Engine Feature Provision made on locomotive for charging main reservoirs from the brake pipe when there is no power on the locomotive (dead) or when the compressor is inoperative.

Dead Head An operating term used to describe off-duty travel of a train crew member from some point back to his or her home terminal. Sometimes the term is used to identify any railroad employee traveling on a pass.

Dead Lever A truck brake lever, the upper end of which is attached to the dead lever guide. Depending on the type of truck brake arrangement, the lower end of the dead lever is either connected to the truck bottom rod (rod under arrangement) or to the brake beam strut (rod through arrangement) with the center hole being pinned to the remaining member.

Dead Lever Guide A steel strap in the form of an elongated "U" attached to either the truck bolster or a point on the car underframe, the function of which is to provide the fulcrum point for the truck dead lever. Dead lever guides on older cars have a series of holes for the purpose of adjusting truck brake rigging to compensate for wheel and brake shoe wear. Single hole dead lever guides are generally used on cars equipped with automatic slack adjusters. Also called "brake lever stop."

Deadlight In passenger car construction the panel between two adjacent windows.

Dead Load In car design calculations, the weight of the carbody with all attachments and appurtenances that will be supported by the trucks. See Live Load.

Deadman Control A pedal or handle, or both, one of which must be kept in a depressed position while a locomotive is operating; usually the brake-valve handle and a pedal which the engineman can conveniently keep depressed at his seat. When pressure is released from both at the same time, they function to cut off the power and apply the brakes.

Dead Truck Lever That part of the foundation brake gear that is connected to the rod receiving its motive force from the live truck lever.

Decal Any lettering or design work printed on a transparent film with a backing which is removed when subjected to water soaking.

Decelakron A device used with electro-pneumatic brakes, through an inertia block and spring. The rate of retardation is measured and the brake cylinder pressure is reduced to prevent excessive retardation.

Decelerate To decrease speed.

Decelostat Controller® The registered trade mark name for a device or an arrangement of devices that through measurement of the rate of retardation causes a rapid reduction of brake cylinder pressure when a wheel slide is imminent. It restores the brake cylinder pressure immediately.

Decelostat Equipment A combination of devices used to measure the rate of retardation and to cause a rapid reduction of brake-cylinder pressure when a wheel slip is starting.

Decelostat Valve A registered trade mark name for the operating valve of the decelostat equipment as well as other equipment.

Dedicated Funding Source A source of monies which by law is available for use only to support a specific purpose, and cannot be diverted to other uses.

De-Energize To lose electric force.

Defect Card A card issued by a railroad acknowledging responsibility for physical damage done to a non-owned railroad car and granting authority to bill the issuing carrier for the cost of repairs in accordance with the code of Interchange Rules published by the Association of American Railroads (AAR).

Defect Card Holder A metal or plastic receptacle positioned on the side of a car suitable for the containment and protection of defect cards.

Delayed Emergency The original name for controlled emergency.

Delivery The pipe or device to which air is supplied.

Delivering Line Subscriber offering a freight car in interchange.

Demand Responsive Non-fixed route service utilizing vans or buses with passengers boarding and alighting at pre-arranged times at any location within the system's service area. Also called "dial-a-ride."

Density Weight per unit of volume, generally expressed as pounds per cubic foot or pounds per gallon in the English system; or kilograms per cubic meter, or kilograms per liter, in the metric system.

Dent A deformation that changes the contour of a railcar from the original manufactured state.

Department of Transportation (DOT) The cabinet level department of the federal government that is responsible for administration of federal transportation programs including public transportation, highways, railroads, air transportation, shipping and the Coast Guard. The Federal Railroad Administration (FRA) is the branch of the DOT that promulgates safety standards for train equipment used in interchange. Each state also has a department of transportation.

Deplete To empty or partially empty the air from a reservoir, pipe, or equipment, etc.

Deposition Destination instructions issued by a car owner to the handling line.

Depreciated Value The reproduction value of a freight car adjusted for depreciation up to the date of damage.

Depressed Center Flatcar A flatcar having that portion of the deck between the trucks lower or closer to the rail to accommodate loads with excessive vertical dimensions.

Depth Gauge A device that allows for measuring the amount of liquid in a tank car.

Derail A track safety device designed to guide a car off the rails at a selected spot as a means of protection against collisions or other accidents; commonly used on spurs or sidings to prevent cars from fouling the main line.

Derailment Anytime the wheels of a car or engine come off the head of the rail.

Designated Satellite Shop (Pool Operation) Any private or railroad shop designated by the pool operator and on the pool operator's line, capable of making repairs to meet the requirements of the shipper.

Designation A letter or numeral, or several of them used together to identify equipment, devices, and parts instead of using long names or descriptions when such is not practical.

Designation of Intermediate Letter "A" Equipped with top-and-bottom shelf couplers. "J" equipped with jacketed thermal protection, tank head puncture head shields and top-and-bottom shelf couplers. "S" equipped with head shields and top-and-bottom shelf couplers. "T" equipped with non-jacketed thermal protection system, top-and-bottom shelf couplers and head shields.

Device A mechanism designed to perform a special purpose. Equipment are made up of devices.

DF A term used to describe an interior lading restraint system for boxcars, using transverse bars (cross bars) engaging special belt rails mounted to the car sides. The initials DF stand for "damage free." See Cross Bar.

DG-GO A drawing made particularly to show how a device or equipment operates; not necessarily accurate as to size, shape, or location of parts.

Dial-a-Ride See Demand Responsive.

Diaphragm A thin elastomeric component used in some valve portions of railway air brake equipment to sense pressure differentials and initiate desired movement to other internal valve components. In passenger car construction, a diaphragm is a rubber or canvas shield used to exclude dust and water from the passageway between two cars.

Diaphragm Pile Sometimes used instead of the term "diaphragm stack."

Diaphragm Stack The diaphragms of an A or F type relay valve that control brake cylinder pressure in proportion to the train speed.

Diesel-Electric Locomotive A locomotive in which power developed by one or more diesel engines is converted to electrical energy and delivered to the traction motors for propulsion.

Diesel Engine An internal combustion engine invented by Rudolf Diesel differing from other internal combustion engines because its compression is high enough to cause combustion without the necessity of introducing a spark for ignition.

Diesel Engine Fuel Efficiency The efficiency of the process whereby the energy in petroleum diesel fuel is converted into useful work by the engine. For a given fuel grade and specification, the energy of a pound or of a gallon of fuel can be determined. Work is measured in terms of horsepower hours. Then, engine fuel efficiency is expressed as horsepower hours per pound of fuel or horsepower hours per gallon of fuel. See also Work and Power.

Diesel-Hydraulic Locomotive A locomotive in which power developed by one or more diesel engines is delivered through a hydraulic transmission to the driving axles by means of shafts and gears.

Diesel Multiple Unit A set of two or more diesel rail cars designed to operate from one control stand.

Differential The difference of pressures created on the two sides of a piston, diaphragm, etc., to move a valve or piston and to make or break a contact, open a port, etc.

Differential Relay Valve A self-lapping relay valve controlled by one or more diaphragms connected together. They function to select the degree of brake cylinder pressure required for a certain speed. This is measured by an axle generator the voltage of which, through relays causes magnet valves to open or close and deliver or exhaust air to the proper diaphragm chambers for controlling the brake cylinder pressure.

Dining Car A passenger train car equipped with facilities for serving meals.

Diode The simplest of the various forms of semi-conductors that allows electric current to flow in one direction only.

Dip Tube See Education Pipe.

Direct and Graduated Release Cap (or Cock) A cap or cock for the purpose of positioning the operating valve so that it will operate in graduated release of direct release.

Direct Current An electric current that flows in one direction only. Often called DC.

Direct Release Brake cylinder air exhausting without interruption that is , not a graduated release.

Dirt Collector A device installed in the air brake system of a freight car used to prevent foreign matter from entering the control valve. See Cut-out Cock.

Disadvantaged Business Enterprise (DBE) A business owned and operated by one or more socially and economically disadvantaged individuals. Socially and economically disadvantaged individuals include African Americans, Hispanic Americans, Native Americans, Asian Pacific Americans or Asian Indian Americans and any other minorities or individuals found to be disadvantaged by the Small Business Administration (SBA) under Section 8(a) of the Small Business Act.

Disc Brake A retardation system used on some rail vehicles, primarily passenger equipment, which utilizes flat steel discs as the braking surface instead of the wheel tread as on conventional brakes.

Discharge Channel The passage through which the fluid must pass beyond the operating parts of a safety relief device. this includes all piping or exhaust flue, screen and weather covering which may be applied on the housing.

Discharge Pipe (Air Compressor) A pipe by which the compressed air is conveyed from the air compressor to the main air reservoir.

Discharge Valve A check valve used in an air compressor to allow air to be forced from the air cylinder to the reservoir or another cylinder, at the same time preventing back-flow.

Discretionary Spending A federal budgetary term that refers to any funds whose distribution is not automatic. Discretionary spending encompasses programs controlled by annual appropriations bills and is subject to the constraints imposed by the discretionary spending limits set in the balanced budget law.

Dismantler A railcar to be sold for scrap.

Dismantler Allowance The compensation due when it has been determined that equipment must be retired and prohibited from re-entering interchange service, Rule 107, AAR Field Manual.

Dispatcher (1) A railroad employee responsible for train route selection and train movements (train dispatcher). On single track lines, the train dispatcher makes arrangements permitting one train to overtake and pass another traveling in the same direction, and for two trains traveling in opposite directions to meet one another. (2) A railroad employee responsible for selection of locomotive units to be coupled together as a locomotive for the purpose of moving a train (locomotive dispatcher, sometimes called engine dispatcher).

Displacement The change that takes place in a cylinder, reservoir, or space when its volume is increased through the outward movement of a piston, diaphragm, or other means.

Displacement, Brake Cylinder The change in cubic measure of the volume of the brake cylinder when its piston moves to full applied stroke as compared to its volume with the piston in its release position.

Displacement, Compressor The cubic measure of the volume of intake air with steam-driven compressors, through the full piston stroke in the air cylinder of single-stage compressors; on the low-pressure air cylinder of compound compressors; and, with other than steam-driven compressors a revolution. Measurement of compressor displacement is usually stated in cubic feet of air per minute.

Displacement Diaphragm A diaphragm used in the displacement reservoir to provide displacement for brakes working in connection with auxiliary reservoir supplied brake cylinders.

Displacement Reservoir Provides proper volume for relay valve; has displacement diaphragm to provide displacement to correspond with brakes on cars with auxiliary reservoir supplied brake cylinders.

Distortion Result of twisting out of proper shape.

Distributed Power Powered locomotives that can be distributed throughout a train allowing more locomotives to pull longer trains without separation from overpowering.

Distributing Valve A device used with the ET equipment that acts as an operating valve to charge, apply, and release the brakes. It may be controlled by the automatic or independent brake valve. It obtains its unlimited supply of air for the brake cylinders from the main reservoir and maintains the proper pressure regardless of brake cylinder leakage or variation in piston travels.

Dog A term sometimes used when referring to the hand brake pawl. A dog is more properly an eccentrically pivoted disc, the function of which is to hold a pawl in place against a ratchet wheel.

Dolly A small square or rectangular-shaped material handling device consisting of a frame on wheel or casters.

Dome A closed vertical cylinder attached to the top of a tank car which provides for expansion of the contents.

Dome Car A passenger car constructed with a raised area in the center of the car with a transparent roof for passenger observation.

Dome Cover The closure for the top of a tank car dome.

Door A general term used to designate either an opening in a freight car for loading and/or unloading, or the component that forms the closure for that opening.

Door Guide A bracket attached to sliding side doors on boxcars, serving to guide the door while it is being opened and closed and to keep it in proper vertical alignment.

Door Hanger A device by which a sliding door is suspended at the top. Most modern freight car door hangers are fitted with rollers which run on a door track.

Door Hasp On freight cars with sliding side doors, a heavy metal strap with a slot that fits over a staple on the door post to secure the door in the closed position. After placing the hasp over the staple, a wedge staple pin is driven through the staple to secure the hasp and a car seal is passed through a small hole in the bottom of the pin.

Door Lifting Lever A device that raises a boxcar door off the door track and throws the weight upon the rollers thus allowing the door to be moved easily.

Door Roller A solid steel roller secured in an assembly at the top and/or bottom of sliding side doors which carries the weight of the door and rolls on the door track to facilitated opening and closing.

Door Sill A cross piece attached to the floor at the door opening.

Door Starter Any one of several devices with high mechanical advantage used to facilitate initial movement of a sliding side door from its closed position.

Door Stop A steel casting welded or bolted to the side of a car that serves to limit the rearward travel of the door.

Door Track A steel angle or channel fastened to the car side at the top and/or bottom of the door opening to secure and support the door and provide the running surface for the door rollers.

DOT See the Department of Transportation.

DOT 103W Insulated or uninsulated non-pressure cars with an expansion dome. Cars built for specific services may require special fittings or materials of construction.

DOT 104W Insulated carbon steel non-pressure tank cars with an expansion dome and having a minimum expansion of 2%.

DOT 105A, 105J or 105S W Insulated carbon steel pressure cars with a manway nozzle, designed for top loading and unloading bottom outlet or washout prohibited.

DOT 107A Uninsulated high pressure service cars having several permanently mounted seamless forged and drawn steel tanks designed to a maximum stress level in the shell.

DOT 109A W Insulated or uninsulated carbon steel pressure tank cars with a manway nozzle, designed for top loading and unloading, bottom washout optional.

DOT 110A W Uninsulated carbon steel tank designed to be removed from the car structure for filling or emptying designed to a burst pressure.

DOT 111A W Insulated or uninsulated non-pressure tank car without an expansion dome and expansion capacity of 2%. Tank cars built for specific services may require special fittings or materials of construction.

DOT 112Aa, 112J, 112S or 112T W Uninsulated carbon steel pressure tank cars with a manway nozzle and designated for top loading and unloading and without bottom connections. They are designed for loading of liquefied compressed gasses or flammable liquids.

DOT 113W Vacuum insulated tank cars having an inner container and carbon steel outer shell designed to hold low temperatures for a long period of time. Tank cars built for specific lading and shipping temperatures may have certain materials and fittings requirements as designated by the intermediate letter: A = Minus 423°F (-253°C) loading; high alloy steel inner container; special fittings and insulation for refrigerated (cryogenic) liquid hydrogen. C= Minus 260°F (-162°C) loading alloy steel inner container; special fittings for refrigerated (cryogenic) liquid natural gas, refrigerated (cryogenic) liquid methane (DOT exemption required), or refrigerated (cryogenic) liquid ethylene. D = Minus 155°F (-104°C) loading; nickel alloy steel inner container; special fittings for refrigerated liquid ethane (DOT exemption required) or refrigerated (cryogenic) liquid ethylene.

DOT 114A, 114J, 114S or 114T W Uninsulated carbon steel pressure car with a manway nozzle and option non-circular cross section. An additional group of valves and fittings may be provided in another location. Designed for loading of liquefied compressed gases or flammable liquids.

DOT 115A W Insulated non-pressure tank cars having an inner container and carbon steel outer shell with optional bottom connections.

DOT 120W (Proposed) Insulated pressure tank cars designed for ambient temperature loading of liquefied compressed gases and/or flammable liquids.

Dot Tank Cars Class Refers to tank cars built to the requirements contained in the Code of Federal Regulations, Title 49, Sections 173.314, 173.319, 173.320 and Part 179 (inclusive).

Double Check Valve One having two seats so arranged that air flowing past either seat cannot flow out past the other seat but will flow through a third common delivery connection.

Double Deck A second floor in a stock car halfway between the ordinary floor and the roof to increase the carrying capacity of the car for small livestock such as pigs and sheep.

Double Door Car Boxcars having two side doors on each side of car. May be plug, sliding or combination of both.

Double Head Two locomotives coupled together and located on the head end of a train, with the power and the independent locomotive brake controlled separately by the engineman of each locomotive.

Double-Heading Cock Now called "brake pipe cut-out cock." A device for cutting out a locomotive's brake valve so that the controlling locomotive or unit will have proper control of the brakes.

Double-Locking Cock One that requires two distinct and opposite forces before the handle can turn the key.

Double Roller Stucki S.B. A truck side bearing commonly applied to 100-ton cars. Marketed by A. Stucki Company.

Double Shelf Couplers Couplers incorporating a feature designed to limit vertical movement between joined couplers thereby preventing accidental disengagement.

Double Transom Truck A four-wheel passenger truck with two bolsters designed to give the same riding qualities as the six-wheel truck.

Double-Welded Butt Joint A butt joint welded from both sides.

Dowel A peg or pin of metal or wood which extends into, but not through, two members of a structure to connect them and maintain a given alignment.

Downtime A period during which a vehicle is inoperative because of repairs or maintenance.

Downtown People Mover (DPM) A type of automated guideway transit vehicle operating on a loop or shuttle route within the Central Business District (CBD) of a city.

Draft A term used to describe forces resulting in tension in the coupler shank. The term "draft" means the opposite of the term "bluff."

Draft Gear A term used to describe the energy-absorbing component of the draft system. The draft gear is installed in a yoke which is connected to the coupler shank and is fitted with follower blocks which contact the draft lugs on the car center sill. So-called "standard" draft gear use rubber and/or friction components to provide energy absorption, while "hydraulic" draft gear use a closed hydraulic system consisting of small ports and a piston to achieve a greater energy-absorbing capability. Hydraulic draft gear assemblies are generally called "cushioning units." See Cushioning.

Draft Gear Carrier A steel plate extending underneath and fastened to the draft sill flanges to support the draft gear or cushion unit.

Draft Gear Cheek Castings Castings welded to the draft sills which serve as stops for the draft gear followers through which the pulling and buffing forces are transmitted to the center sills. These may be four separate castings but generally each pair (front and rear) is cast together as a center-sill filler.

Draft Gear Pocket The space in the draft sill that contains the energy-absorbing components of the draft system. The draft gear pocket is formed by the draft sill top cover plate, the draft sill webs, the front and read draft lugs, and the draft gear carrier plate.

Draft Key A heavy steel bar used to connect the coupler shank to the yoke.

Draft Key Retainer A pin inserted at one end of the draft key to prevent it from backing out through the slot in the center sills.

Draft Lug One of a set of stops riveted, bolted or welded to the draft sills and transmitting to them the stresses received from the draft gear.

Draft Pin A special railroad tool of round steel tapered for insertion to align holes by striking the large end.

Draft Sill That portion of the car center sill outboard of the body bolster containing the various components of the draft system.

Draft System The term used to describe the arrangement on a car for transmitting coupler forces to the center sill. On standard draft gear cars, the draft system includes the coupler, yoke, draft gear, follower, draft key, draft lugs and draft sill. On cushioned cars, either hydraulic end-of-car cushion units and their attachments replace the draft gear and yoke at each end; or a hydraulically controlled sliding center sill is installed as an integral part of the car underframe.

Drag The ratio of resistance to motion of a car, a locomotive unit or a train to the weight of that car, unit or train. That is, drag is determined by dividing the resistance to motion by the weight. Drag is expressed in pounds (resistance) per ton (weight). Train drag consists of the sum of bearing drag, flange or speed dependent drag, aerodynamic or speed squared dependent drag, grade drag and curve drag. See Train Resistance.

Drag Force Drag multiplied by weight of locomotive, cars or train producing the drag. Resistance to motion.

Drain To draw air or water or both from some part of the brake apparatus.

Drain Cock A device to open and close the passage or pipe for draining air brake apparatus.

Drain Valve In passenger car steam heat systems, a valve used for draining off water condensed in the steam pipes where an automatic trap is not used. Also used for draining moisture from air reservoirs.

Drawbar The mechanism for coupling together cars and locomotive units. A term formerly used synonymously with coupler. It has been used indiscriminately to designate both the old link and pin drawbar and the modern automatic car coupler.

Drawbar Coupler The mechanism for coupling together cars and locomotive units. Also referred to as coupler.

Drawbar Force The force exerted through the couplers by the locomotive on coupled cars, by one car upon another, etc. This force is usually greatest at that coupler between the last locomotive unit and the first coupled car in the train.

Drawbar Pull A tensile coupler force. Locomotive pulling power is sometimes expressed in terms of "pounds of drawbar pull."

Drawbar Slack Slack in the coupling system. This slack permits a small amount of unrestrained relative motion between adjacent, coupled cars and may be as much as six inches per car. Thus, in a 100 car train, the relative motion between first and last car could total 50 feet. Cushioning devices in the draft system on each car will add to the total relative motion permitted between each car and hence between first and last car.

Draw Head The head of an automatic coupler.

Drift Pin (1) A special railroad tool of round steel tapered for insertion to align holes by striking the large end. (2) A tapered steel pin, 12" to 18" in length, used to align bolt boles at rail joints.

Driving Wheel Any of the powered wheels under a locomotive.

Drop Bottom Car A gondola car with a level floor or bottom equipped with a number of drop doors for discharging the load.

Drop Door A door at the bottom of a hopper or gondola car for unloading it quickly by allowing the load to fall through the opening.

Drop Door Chain A chain attached to a drop door and usually connecting it with a winding shaft for the purpose of controlling the door. Also sometimes termed "hopper chain".

Drop End Gondola Car A gondola car with ends which can be dropped when the car is used for shipping long material which extends over more than one car.

Drop Forging One made by the use of dies under a drop hammer.

Drop Shaft Brake A horizontal wheel hand brake for flatcars with an arrangement for lowering the hand-wheel close to the floor to accommodate lading.

Drop Table Shop equipment used to lower car or locomotive trucks from under the superstructure.

Drop Test The ductility and impact resistance of finished metal shapes is determined by the drop test which uses a fixed weight falling from a predetermined height and delivering a blow or shock to the metal shape, which rests on supports attached to an anvil. A similar test (called a "drop hammer" test) conducted under highly controlled and instrumented conditions is used to certify AAR approved draft gears.

Drum (Hoisting Gear) The main cylinder upon which the hoisting rope winds and unwinds.

Drum Shaft (of a Derrick or Crane) The shaft on which the winding drum is carried.

Dual Control Switch A power-operated switch which is also equipped for hand operation.

Dummy Hose Coupling (Air Brake) A casting, the same shape as a hose coupling, into which the coupling may be hooked. It is used to prevent dirt and debris from getting into the brake pipe, as well as preventing the coupling hose from hanging down when not in use and being damaged. Dummy couplings are also used to seal off the brake hose during tests of the air brake equipment on cars.

Dump Car A car from which the load is discharged either through doors or by tipping the carbody.

Dunnage Waste material such as wooden blocks or steel pads used to support and secure lading in or on a freight car.

Duplex Release Valve (Bleeder) A two-valve mechanism with the draining of auxiliary reservoir air controlled by one valve and emergency reservoir air by the other. A rod leading to both sides of car on freight cars or the handle on passenger cars, pulled slightly, opens the valve to drain auxiliary reservoir, when pulled full distance, both valves open to drain both reservoirs.

Dust Collector (1) A device for preventing dust or pipe scale from passing to an air valve mechanism. It usually operates on a centrifugal system of separating the foreign particles from the air. (2) A bag house system for controlling emissions.

Dust Guard A thin piece of material inserted in the dust guard chamber at the back of a journal box and fitting closely around the dust guard bearing of the axle. It is used to exclude dirt and prevent the escape of oil.

Dwell Time The scheduled time a vehicle or train is allowed to discharge and take on passengers at a stop, including opening and closing doors.

Dynamic Brake A type of electrical locomotive brake created by reconfiguration of the traction motors, making them into electrical generators. An effort is required to turn or rotate a generator; the effort acts to retard and brake the motion of the locomotive and coupled train. Current produced by the generators is converted into heat and dissipated by dynamic brake grids.

Dynamic Brake Regulator A device which prevents braking grid amperage from exceeding a predetermined value.

Dynamic Brakes A means of causing retardation in a self-contained locomotive by dissipation of power in air-cooled grids.

Dynamic Braking A term used to describe a method of train braking whereby the kinetic energy of a moving train is used to generate electric current at the locomotive traction motors, which is then dissipated through banks of resistor grids in the locomotive carbody.

Dynamic Braking Resistors Grid resistors which are mounted just under the roof of the locomotive. The power from the traction motors, operating as generators during dynamic braking, is dissipated through the resistors.

Dynamite A slang term used to describe the initiation of an emergency air brake application on a train.

Dynamiter A slang term for a car with a defective control valve which will create an emergency brake application and serially propagate the emergency application throughout the train even though such action was not desired by the crew. Common causes are stuck valves in the car's control valve, or the opening of these valves due to the vibration and/or slack action of the car. Also called "kicker."

Dynamometer A device for determining the power of an engine.

Dynamometer Car A car equipped with apparatus for measuring and recording drawbar pull, horsepower, brake pipe pressure, and other data connected with locomotive performance and train haul conditions.

E

"E" Coupler A standard AAR automatic coupler. Type "E" couplers are cast in several grades of steel, and have several shank configurations to meet varying service requirements.

Early Warning A directive issued by the AAR for interchange freight cars having mechanical defects or potential safety problems.

Earmark A federal budgetary term that refers to the specific designation by congress that part of a more general lump-sum appropriation be used for a particular project; the earmark can be designated as a minimum and/or maximum dollar amount.

Eave The edge of the roof projection over the sides of a car.

Eddy Current Clutch A magnetic clutch on some Alco locomotives which connects the radiator fan with an engine-driven shaft without a mechanical connection.

Education Pipe Guide (Siphon Pipe Guide) Generally a fabrication mounted to the tank bottom whose purpose is to stabilize the siphon pipe.

Education Pipe (Siphon Pipe) A pipe that extends from the top of a tank car to the bottom, often extending into a bottom sump, thereby enabling the tank contents to be unload by means of pumping or pressurization.

Effective Date The date a standard, specification, design, product or device, must be placed in effect for equipment interchange service. (AAR)

Electric Circuit See Circuit, Electrical.

Electric Controls (for Air Brakes) Used in many cases to obtain quicker response, for measuring pressures by speeds, and for various interlocking features.

Electric Furnaces Three electric arc furnaces melt steel which is tapped at approximately 3,000 degrees F.

Electric Heater A heater powered by electricity passing through resistance coils with appropriate control and regulating devices.

Electric Locker A locker in which the electrical control devices for lighting or air conditioning are housed.

Electric Locomotive As distinguished from a gas-electric or diesel-electric locomotive, a self-propelled vehicle, running on rails and having one or more electric motors that drive the wheels and thereby propels the locomotive and train. The motors obtain electrical energy either from a rail laid near to, but insulated from, the track rails or from a wire suspended above the track. Contact with the wire is made by a pantograph or trolley wheel on the end of a pole mounted on top of the locomotive.

Electric Motor Car A vehicle for operation of track rails, used for the transport of passengers or materials, the propulsion of which is effected by electric motors mounted on the vehicle.

Electric Test Box A portable box containing electrical elements with which check tests at railroad terminals and shops may be made of electric circuits and devices.

Electric Trainline A continuous electric conductor extended between cars by means of jumper cables or couplers so that power or control signals can be transmitted to and/or from each car to permit simultaneous control of traction motors and other vehicle carried equipment. An electric trainline may include circuits for auxiliary electric brakes, communication, engine controls and other devices.

Electrically Locked Switch A hand-operated switch equipped with an electrically controlled device which restricts the movement of the switch.

Electrification A term used to describe the installation of overhead wire or third rail power distribution facilities to enable operation of trains hauled by electric locomotives.

Electrode Commonly a consumable steel rod or wire through which electric current is conducted from an electrode holder to a welding arc. The electrode is consumed by providing the filler metal for the weld.

Electronic Alertness Control (Alerter) A type of safety control system involving a low-powered radio frequency circuit that senses the movements of an engineman. The locomotive engineer's seat is equipped with a built-in antenna. As the locomotive engineer goes about his normal activity, such as adjusting the throttle position or applying the brakes, sanding, blowing the horn, etc., these motions produce a detectable change in the energy output of the seat antenna. Any such changes will reset the control and start a timing circuit.

Electro-Pneumatic Combination of electrical and compressed air devices and equipment used in controlling and operating certain functions in air brakes.

Electro-Pneumatic Brake A braking system used on high-speed electric passenger trains. Brakes are applied and released on each car through the action of electro-pneumatic valves energized by current taken from contacts on the engineman's brake valve and continuous train wires. Brakes can be applied instantaneously and simultaneously with this device, eliminating undesirable slack action and providing more positive control of train speed. Extensive experimentation is taking place in the field and will probably result in use of some variation of this type of brake system on freight trains in the not-too distant future. Some of the principal benefits will be better control of slack action, improved brake application times and graduated release.

Electro-Pneumatic Straight-Air Brake An electrically controlled air brake used in combination with an automatic air brake.

Electro-Pneumatic Switch A switch operated by an electro-pneumatic switch-and-lock movement.

Electro-Pneumatic Valve A valve electrically operated which, when operated, will permit or prevent passage of air.

Elevated (Railway) See Rail, Heavy.

Elliptic Spring A spring whose shape resembles an ellipse. Made of two sets of parallel steel plates called "leaves," of constantly decreasing length. Such springs were once widely used for bolster springs for passenger cars.

Emergency Application (Air Brake) The type of brake application made when a train must be stopped in the minimum distance possible for the equipment. It may be made from the conductor's valve or from the engineer's brake valve on the locomotive or power car. An emergency application may also occur when a brake pipe is broken or when air hoses between cars are disconnected when angle cocks are open. An emergency application is brought about by the very rapid exhausting of air pressure from the brake pipe, and results in a correspondingly rapid build-up of brake cylinder pressure.

Emergency Brake Valve (Conductor's Valve) Used to make an emergency rate of reduction in the brake pipe.

Emergency Coupler A short shank coupler which can be chained in place if the standard coupler is pulled out or broken.

Emergency Knuckle A coupler knuckle which is designed for use in case of damage to the knuckle of an automatic coupler.

Emergency Portion (Air Brake) One of three parts of the air brake control valve. The emergency portion controls the build up of brake cylinder pressure during emergency brake applications, and, in the ABDW control valve, contributes the improved performance (quicker response) during service applications.

Emergency Rate The speed with which the brake pipe pressure must reduce to cause a device to assume its quick-action emergency position.

Emergency Reduction Reduction of brake pipe pressure at an emergency rate.

Emergency Relay Valve A device actuated by main reservoir air from the automatic brake valve when in emergency position, opening a poppet type valve to cause brake pipe air to reduce at an emergency rate, even though the double-heading cock is closed.

Emergency Reservoir A compressed air storage tank; part of the air brake equipment on each car. Air stored in the emergency reservoir is used to apply the brakes during an emergency application, and to assist in releasing the brakes and recharging the system during brake release operations. See Auxiliary Reservoir.

Emergency Trip Magnet Valve A device used in connection with a trip switch, conductor's switch, or Cineston handle to cause an emergency application valve to operate when the above switches operate or pressure is removed from the Cineston handle.

Emergency Trip Switch Operates in conjunction with an application valve and an emergency trip magnet valve to produce emergency brake applications when actuated by roadbed trip mechanism.

Emergency Valve A device for the purpose of causing an automatic emergency application, with automatic sanding included in some types.

Empty-and-Load Brakes A brake arrangement used on some freight cars that allows for two levels of braking, depending on whether the car is empty or loaded. Empty and load brakes are required when the difference between the empty and loaded gross weights of the car is greater than can be accommodated with single capacity brake equipment within the braking limits established by the Association of American Railroads.

Empty-and-Load Valve An operating valve for a double-capacity brake generally used on cars that operate empty or fully loaded.

Empty Weight See Light Weight.

EMU See Multiple-Unit Cars.

End Door A door arrangement in the end of a boxcar generally used for loading long commodities that cannot be loaded easily through side doors.

End Frame The frame which forms the end of a carbody. It includes the posts, braces, belt rail and end plate.

End Ladder A ladder mounted at the end of a car providing access from the end platform to a top walkway or platform.

End Loading See Circus Loading.

End-of-Car Cushioning Device A unit installed at the ends of a car that develops energy-absorbing capacity through a hydraulic piston arrangement supplemented by springs to assure positive repositioning of the unit. These devices replace the standard draft gear, and provide up to 15 inches of travel.

End-of-Train Device Device that monitors air brake system and train integrity on trains being operated without a caboose.

End Plate A member across the end and connecting the tops of the end posts of a carbody and fastened at the ends to the two side plates. It is usually made of the proper form to serve as an end carline.

End Platform (1) A narrow, full car width platform located at each end of a car approximately 48 inches above the rail. (2) The structural piece of a passenger car, usually of cast steel, which is used at the ends of the frame and generally containing pockets for the installation of draft gear.

End Play (Axle) The movement or space left for movement between journals. In reference to truck bolster, it is usually called "lateral motion."

End Post The vertical members in the end body framing between the corner posts. With reference to hopper cars, a vertical support for the overhang of the hopper floor, resting on the end sill.

End Sheet A plate used in closing the end of a steel car.

End Sill The transverse member of the underframe of a car extending across the ends of all the longitudinal sills. In steel underframe cars, a rolled or cast section or a pressed plate.

End Sill Brackets Angle plates used to connect the longitudinal sills and the end sill. In bridge building such plates are termed brackets. When of triangular section they are termed "gussets."

End Sill Diagonal Brace Horizontal brace extending from the end sill diagonally back to or beyond the bolster.

End Sill Plate A plate extending the full length and width of a built-up end sill, and attached to the other members.

End Slope The sloping floor from the end of a hopper car to the hopper door. See Slope Sheet.

End Top Angle On open-top cars the end sheets are usually reinforced by this member which corresponds to the end plate on closed cars.

Endurance Limit The highest unit stress, the repeated application of which can be indefinitely endured without failure.

Energy The ability to do work. See Work.

Engine A mechanism for converting the energy in steam, air or other gas under pressure into mechanical energy in the form of motion. Usually restricted to reciprocating engines having a cylinder, reciprocating piston and means for causing the gas under pressure to expand alternately on one or both sides of the piston and move it back and forth in the cylinder. The terms also includes the means of transforming the reciprocating motion of the piston into rotary motion, usually consisting of a connecting rod and crank. Frequently used as meaning the entire locomotive. See Internal Combustion Engine (slang) The Locomotive.

Engine Base In a locomotive, the structure on which the engine frame is supported and which is bolted to the locomotive frame.

Engine Frame In an internal combustion engine, the structural frame of the engine in which are secured the cylinder liners and water jackets. Sometimes referred to as "crankcase" or "cylinder block."

Engineer's Brake Valve The original name for an automatic brake valve which is used primarily to control the flow of air into and out of the brake pipe to cause operating valves to charge, apply, and release brakes.

Engineers' Console The panel for the engineer fo a locomotive or cab car which contains the main operating controls.

Enginehouse Facilities provided for maintaining locomotives and making light repairs.

Engineman The driver or operator of a locomotive or locomotive consist.

Enhanced-Visibility Workwear Personal pretective colthing that is either accented with or constructed entirely in reflective lime green, yellow, or orange material.

Envelope Air Distribution A form of air distribution for refrigerator cars in which all of the cooled or heated air is passed in ducts and flues between the lading space and the insulated outer structure.

Environment The water, air, land, and all plants, humans, and animals living therein, and the inter-relationships which exist among them.

Environmental Impact Statement (EIS) A comprehensive study of likely environmental impacts resulting from major federally-assisted projects; statements are required by the National Environmental Policy Act (NEPA).

Environmental Protection Agency (EPA) The US Environmental Protection Agency established in 1970 by Presidential Executive Order, bringing together parts of various government agencies involved with the control of pollution.

Equalization Pressures becoming the same, as where two or more volumes having different air or steam pressures are connected or the pressures on two sides of a piston become the same.

Equalizer In six-wheel and some four-wheel truck arrangements, a system of bars, rods, levers and springs that serves to equalize the loads on the axles and provide improved riding qualities for the truck.

Equalizer Spring A spring which rests on an equalizing bar and carries part of the weight of a car. Single or double coil spiral or helical springs are general used for this purpose.

Equalizer Spring Cap A casting which fits over the top of the equalizer spring and transmits to it the weight received from the wheel piece.

Equalizing Brake Lever A floating brake lever used to equalize forces in the brake rigging.

Equalizing Discharge Valve That part of the equalizing piston valve portion or the automatic brake valve that opens and closes the brake pipe exhaust for controlling the flow of brake pipe air during service brake pipe reductions.

Equalizing Lever Set An arrangement of cylinder levers and connections for double-truck cars, so designed to ensure proper equalization of braking force on both trucks with either the hand or air brake.

Equalizing Piston A common name given to pistons used in brake valves, distributing valves, universal valves, etc., providing the means for operating valves, etc., through creating a difference of pressures on the piston.

Equalizing Piston Valve Portion A device used as a portion of a brake valve, brake application valve, etc.; where used separately is called "equalizing piston valve." The purpose is to cause brake pipe pressure to be reduced at a service rate. It includes an equalizing piston, equalizing discharge valve, and a maintenance valve for first service function.

Equalizing Reservoir The small reservoir connected to an equalizing piston chamber to add volume to the piston chamber of the automatic brake valve,, to provide uniform service reductions in brake pipe pressure regardless of the length of the train.

Equipment (Brakes) A combination of devices usually connected by piping, fittings, etc., for accomplishing specific functions.

Equipment (Railcars) Rolling stock of the kind generally used by American railroads in revenue freight service.

Equipment Register A tariff setting forth ownership, reporting marks, marked capacity, length, dimensions and cubical capacity of cars used to transport freight: however, not gallonage on tank cars for tariff purpose.

Escutcheon A plate or guard for the keyhole of a lock.

Ethanol An alternative fuel; a liquid alcohol fuel with vapor heavier than air; produced from agricultural products such as corn, grain and sugar cane.

Event Recorder A device, designed to resist tampering, that monitors and records data on train speed direction of motion, time, distance, throttle position, brake applications and operations (including train brake, independent brake, and, if so equipped, dynamic brake applications and operations) and, where the locomotive is so equipped, cab signal aspect(s), over the most recent 48 hours of operation of the electrical system of the locomotive on which is it installed. A device, designed to resist tampering, that monitors and records the specified data only when the locomotive is in motion shall be deemed to meet this definition provided the device was installed prior to (date) and records the specified data for the last eight hours the locomotive was in motion.

Event Recorder, In-Service An event recorder that was successfully tested and whose subsequent failure to operate as intended, if any, is not actually known by the railroad operating the locomotive on which it is installed.

Excess Flow Valve A valve normally installed within vapor and liquid (siphon) pipes of a pressure car intended to shut off flow out of the tank once a certain flow rate is reached. Also called a Check Valve.

Excessive That which passes the required limit.

Excess Pressure The difference in pounds per square inch in the main reservoir over that in the brake pipe above the pressure of equalization of the brake equipment, such as 50 lb from a 70 lb charge equipment.

Exciter An auxiliary generator which supplies power for the field excitation of another electrical machine.

Exclusive Right-of-Way A highway or other facility that can only be used by buses or other transit vehicles.

Executive Order 12372 A presidential directive that furnishes guidance to federal agencies for cooperation with state and local governments in the evaluation, review and coordination of federal assistance programs and projects.

Exhaust The products of combustion from an engine cylinder. Also, the air discharge from the brake pipe or brake cylinder during operation of the brake equipment. The reduction of air or steam pressure by flow from one container to another or to the atmosphere. May or may not entirely empty the container.

Exhaust Manifold A conduit connecting each cylinder of the engine to common outlet to carry the burned gases to the exhaust pipe.

Exhaust Stack The ducts placed on top of the hood or cab to convey the exhaust gases away from the locomotive.

Exhaust Valve Any valve that controls the flow of exhaust air or products of combustion.

Expander Ring The spring wire used to hold the bearing skirt of a piston packing cup in contact with the cylinder wall.

Expansion Cycle (Internal Combustion Engines) The portion of the power stroke during which the combustion gases exert pressure on the moving piston and expand while the pressure falls.

Expedite Track A repair location not meeting the definition of a repair track (i.e. mobile repair vehicles and tracks performing repairs not requiring full repair equipment).

Express Car A specially constructed car, operated in passenger trains and used for transportation of express shipments; sometimes combined with facilities for handling baggage or mail.

Express Train A passenger train operating on fast schedule and not stopping at all stations on its route; also a train consisting of "express freight."

Extended Range Dynamic Brake A dynamic brake control for low train speed operation, which increases the braking effort in speed ranges down to about 6 mph. High braking grid amperage is obtained by the controls which automatically short out the braking grid resistance in small increments as train speed reduces below about 23 mph. This feature may also be referred to as "variable speed-braking."

Exterior Heater Pipes A general term used to identify all heating systems which consist of exteriorly mounted half ovals, pipes or channels welded to the outside of the tank.

F

Fabricate (Tank Car) To construct a tank car tank, consisting of a shell and heads, with connections welded directly thereto, with or without stub sill and body bolster components.

Fabrication Inspection Tests performed as necessary prior to assembly, during welding, and after welding to ensure that the materials and workmanship meet the requirements of the specification and standards documents.

Facilities Track ties, roadbed and related structures including terminals, team tracks and appurtenances, bridges, tunnels, and other structures used or usable for rail service operations.

Fading Choke The choke that vents the equalizing reservoir, reduction limiting reservoir, and chamber D air to the atmosphere in the first service position of the brake pipe pressure.

Fair Condition A railcar status denoting that the railcar has no serious damage, is able to be placed both in Interchange and "revenue service" with no cause for rejection but needs preventive maintenance.

Fall protection Safety equipment designed to prevent falls and minimize injury in the case of falls.

False Gradient That difference in brake pipe pressure between the front and rear of a train when the brake equipment is not charged as much as is possible with the particular feed valve setting.

False Piston Travel The difference of travel between where the brake shoes just come against the wheels and where the brake is fully applied, sometimes said to be the difference between running and standing travel.

Fare Box Recovery Ratio Measure of the proportion of operating expenses covered by passenger fares; found by dividing fare box revenue by total operating expenses for each mode and/or systemwide.

Federal Transit Act See Section.

Feed Groove A small channel cut in the bushing of an operating valve to permit the flow of air from the brake pipe side of the piston to the auxiliary reservoir or pressure chamber when in charging position. It also acts as a stabilizing port to prevent movement of the piston due to minor fluctuations in brake pipe pressure.

Fillers A nonconsumed metallic strip or bar used in a lap or tee-joint to reduce a gap.

Fill Hole Generally refers to the relatively small opening (with bolted and hinged cover) located on the manway cover plate of acid cars through which the car is loaded.

Fillet Weld Leg The distance from the joint root to the fillet weld.

Filling Spider See Bolster Center Filler.

Filter A cleaning or straining device in which the cleaning element is wholly or in part made of felt.

Finding of No Significant Impact (FNSI) A document prepared by a federal agency that presents the reasons impact: why a proposed action would not have a significant impact on the environment and thus would not require preparation of a Environmental Impact Statement. An FNSI is based on the results of an environmental assessment.

First Class Condition A railcar status denoting that the railcar, in addition to meeting "good condition", is of the identical quality and workmanship as a newly manufactured railcar; a structure which has no wear and tear, obsolescence or other diminution of economic value as compared to a newly manufactured railcar.

First Service A feature used with automatic train brake applications in which a light initial brake pipe reduction at a service rate is made. This is followed by a controlled continuous slower reduction.

Fixed Brake Lever See Dead Lever.

Fixed Choke Orifice A nonchangeable restricted opening into a cavity or to atmosphere.

Fixed Tube Gauging Device A tube, mounted on the top fittings nozzle, extending into the tank at a fixed distance. Commodity flowing out of the valve at the top of the tube indicates that the liquid level is at or above the bottom of the tube. It is also known as a "tell-tale".

Flanged Off Refers to a tank nozzle or saddle upon which valves or other fittings would normally be mounted, but is instead closed off with a blind flange.

Flange Drag Drag which is proportional to the speed of the vehicle or train. Although traditionally attributed to contact of the wheel flange with the rail, the vertical stiffness (softness) of the track structure is usually the major contributor to this drag. See Drag.

Flash The material which is expelled or squeezed out of a weld joint and which forms around the weld.

Flashing Relatively small pieces of jacket material used to achieve a tight fit around nozzles and other appurtenances that protrude through the jacket of an insulated tank car.

Flat Maintaining Application Supplying air into the brake pipe to prevent brake pipe leaks from increasing a desired brake pipe reduction.

Flexibility The ability of brakes to apply and release with a high degree of speed and accuracy.

Flexible Metallic Joint A metallic joint so designed as to provide for flexibility. A swing joint. Also called "ball and socket joint".

Floating Connecting Rod A rod which connects a cylinder lever with a floating lever.

Floating Lever A lever used in brake rigging to equalize forces in the system.

Floating Lever Bracket A bracket attached to the underframe of a car to carry the floating lever of the brake gear.

Floating Lever Hanger A bracket or hanger supporting the floating lever.

Flow Compressed air expanding from a higher pressure to a lower pressure from one receptacle to another is called air flow.

Flow Control A term given to devices that are used to open and close the means for the passage of air with no pressure regulation.

Flow Rating Pressure The inlet static pressure at which the relieving capacity of a safety relief device is measured for rating purposes.

Flow Sensor Monitors the charging rate to the train line.

Fluid Air Pressure The condition of air to always expand uniformly to the utmost limits of the containing space.

Fluoroscope A phosphorus screen, x-ray intensifier used to detect defects in tank welds.

Fluorotape A tape recording of an image from the output of a fluoroscope. The image is recorded on video magnetic tape for playback on a suitable television receiver.

Flush-Deck Car A type of carbody construction in which the side sills (the longitudinal structural members at the sides of the underframe) do not extend above the deck. This type of construction makes the car more versatile for a variety of loads. There are both standard-level and low-level flush-deck cars.

Foam A shortened term for polyurethane foam insulation; a high efficiency insulation used in insulated tank cars transporting highly temperature sensitive products. Not generally used on cars equipped with heater coils.

Foolproof Refers to parts so designed that it is impossible to assemble them incorrectly without undue force or mutilation.

Foot Valve To prevent safety control brake application by the engineer or operator keeping it depressed with his foot.

Force A push or a pull on an object such as a train.

Foreign Repair Any repair performed to an interchange freight car by a company other than the car owner or car owner's agent in the case of contract shop repairs.

Forge Welding A welding process wherein coalescence is produced by heating in a forge, or other furnace, and by applying pressure or blows.

Four-Way Cock Having four connections so that adjacent openings may be connected in pairs.

Fracture A complete separation of material extending through the entire cross section of the plate.

Frame (1) A structure composed of a number of members designed and arranged to withstand the stresses set up in the particular part of a car for which it is intended and to provide the supporting structure for the sides, floor and ends of the car. See Underframe. (2) The load bearing structure of a railcar not including the running gear; provides the supporting structure for the sides, floor and ends of the car.

Frangible Disc The operating part of a safety vent designed to burst at a predetermined tank pressure.

Free/Unrestricted Interchange Service A freight car placed in the North American interchange system recognized as meeting all interchange requirements. Also referred to as interchange service.

Freight Car A car designed to carry freight, or railroad personnel, by rail and includes: box car, refrigerator car, ventilator car, stock car, gondola, hopper car, flat car, special, caboose car, tank car and yard car.

Freight Car Brake The standard freight car brake which consists of a AAR approved control valve, the brake cylinder, the auxiliary and emergency reservoirs combined in a single unit, and the dust collector, cutout cock and retaining valve. Its functions are high-speed serial action in service applications effective through a train of 150 plus cars, effective cylinder pressures throughout the train with light brake pipe reductions, assured release, uniform recharge, emergency always available after application or release, controlled emergency which prevents severe shocks, and quicker and more positive release after emergency.

Friction The resistance to motion of two surfaces in contact with each other.

Friction Block A casting attached to the truck bolster as a guide and which absorbs wear between the bolster and transom. Commonly called "bolster guide".

Friction Block Side Bearing A truck side bearing consisting of a loose block of steel retained by a bracket on top of the truck bolster. See Side Bearing.

Friction Roller A wheel or pulley interposed between an object and the surface over which it moves to diminish the friction.

Fuel Cut-Off Switch A switch mounted on the outside or in the cab or a locomotive which may be used in emergency situations to stop the flow of fuel into the engine.

Fuel Use Rate The number of gallons or pounds of fuel burned by a locomotive's diesel engine per hour or per minute. Typically expressed in gallons per hour, pounds per hour, etc.

Full Fillet Weld A fillet weld whose size is equal to the thickness of the thinner member being jointed.

Full Release A term that through common usage has been strongly established instead of release position, which is the automatic brake valve position in which main reservoir air is connected directly to the brake.

Full Service Application Same as full service reduction except that the application is not entirely completed until the brake is entirely released.

Full-Service Lease A lease where the lessor pays all taxes, maintenance, repair, and insurance in addition to a monthly lease rate.

Full Service Reduction Reducing the brake pipe pressure at a service rate high enough to cause the reservoir (auxiliary or pressure chamber, auxiliary and service reservoir, etc.) to equalize with the brake cylinder (or other controlling cylinder, reservoir, or chamber, or combination that acts as relay for supply of air to the brake cylinders). A safety valve may be used to prevent obtaining maximum pressure in the brake cylinders.

Fused Metallic Backing A metal backing placed against the back side of the joint to support and maintain molten metal. The material is partially fused during welding.

Fusee A red flare used for flagging purposes.

Fusible Plug A non-reclosing safety relief device designed to function by yielding or melting of a plug of suitable material.

Fusion Welding The melting together of base metal and filler metal, or base metal only, to achieve coalescence in welding operations.

Fusion-Type Discontinuity Signifies slag inclusion, incomplete fusion and similar discontinuities associated with fusion.

G

Gage In general terms, any device used for measuring an independent quantity such as pressure rate of flow, volume, length, area, etc. An instrument with a calibrated scale or dial for measuring or indicating quality. An analog typed readout.

Gage Glass A volume gage consisting of a clear vertical glass tube connected at the top and bottom with a tank so as to indicate the height of liquid contained in the tank.

Gage (Track) See Standard Gage.

Gai-Tronics The Taconite Facility intercom system.

Gallery Car A passenger car normally employed in commuter service which contains a main seating level and an upper deck level with an open aisleway through the center which gives a "gallery" appearance to the car interior.

Galvanized An electrolytic process by which sheet metal or steel is coated with a film of zinc to retard oxidation.

Gasket A thin sheet of rubber, cloth, sheet metal or some other material, inserted in a joint between two mating surfaces to prevent leakage of whatever fluid is to pass through the joint.

Gas Pocket A cavity caused by entrapped gas.

Gas-Turbine Electric Locomotive A locomotive in which power is developed by a gas turbine which drives electric generators supplying current to electric traction motors on the axles.

Gate Sometimes used to describe the bottom door assembly that serves as a discharge opening on covered hopper cars, usually called the "discharge gate." In metal casting operations the gate is the opening in the mold through which the molten metal is poured.

Gate Valve A device for controlling the flow of fluid in a pipe by means of a moveable closure that, when fully closed, effectively forms a "gate" across the opening at right angles to the direction of flow. Gate valves are generally found in large diameter pipes, while ball and plug valves are more common in smaller pipes.

Gauge See Gage.

Gauging Device A system which furnishes an indication of liquid levels inside the tank.

Gear A disc or wheel made with uniform notches around its circumference so as to form teeth that engage mating teeth on another gear to transmit torque from a driving shaft to a driven shaft.

Gear Case An enclosure for the gear and pinion of a railway motor to exclude dirt and water.

Geared Hand Brake A hand brake arrangement that employs gears to multiply and transmit forces applied at the hand wheel.

Gear Ratio A pair of numbers expressed as a ratio, such as 48:12 (reads as, 48 to 12), used to describe the mechanical advantage or multiplying power of a pair gears in a system. In the example given, the small gear (12 teeth) will turn four (4) times for every single revolution of the large gear (48 teeth), but the large gear will provide four times as much torque to its shaft as is delivered to the small gear.

Generator A rotating electrical machine which changes mechanical energy into electrical energy. The main generator on a diesel-electric locomotive receives power from the engine and delivers electrical energy to the traction motors.

Generator Regulator A device which controls the voltage and current output of an axle-driven electric generator to suit the needs of batteries, lights and other locomotive electrical equipment and at the same time protects the generator from injury at all train speeds.

Gib A protruding wing or guide, cast in pairs on each end of a truck bolster. The gibs form a kind of channel that fits and bears on the column guide surfaces of the side frame when the truck is assembled.

Gib and Key A fastening to connect a bar and strap together by a slot common to both, in which a gib with a beveled back is first inserted and then driven fast by a taper key.

Gib Nut A type of lock nut which derives its holding power from bent down edges, which, upon coming in contact with the holding nut are bent up and force the nut threads into those of the bolt to form a jam.

Girder A type of beam used in construction, often used as the side members of a bridge.

Glad Hand The term used to describe the metal fitting attached to the free end of each air hose. Glad hands are designed to provide for quick and positive connection of air hoses on adjacent cars.

Gland In valve assemblies, that part of a stuffing box which surrounds the rod or stem and is pressed against the packing as the stuffing-box nut is tightened.

Glazing, Certified A glazing material that has been certified by the manufacturer as having met the testing requirements set forth and has been installed in such a manner that it will perform its intended function.

Glazing, Emergency Window Opening That segment of a side facing glazing location which has been designed to permit rapid and easy removal during a crisis situation.

Glazing, End Facing Glazing Location Any location where a line perpendicular to the plane of the glazing material makes a horizontal angle of 50 degrees or less with the centerline of the locomotive, caboose or passenger car. Any location which, due to curvature of the glazing material, can meet the criteria for either a front facing location or a side facing location shall be considered a front facing location.

Gondola Car The common gondola car is a freight car with low sides and ends, a solid floor, and no roof. It is used mainly for transportation of coal, iron and steel products and other lading not requiring protection from the weather. Special types of gondola cars are built with high sides (for coal), removable covers (for steel or aluminum coils), and other attachments for some specialized service. Some of the newer gondola cars are constructed of aluminum.

Good Condition A railcar status denoting that the railcar is able to be placed both in interchange and revenue service with no cause for rejection, has no damage, needs no preventative maintenance, free from rust and corrosion, and has no bare metal exposed.

Gouge A deformation caused by mechanical means, that results in the loss of parent metal or weld metal. Also used to refer to the act of arc gouging for weld metal removal.

Government Directive Any instruction issued by a federal, state or local agency pertaining to inspection, repair or disposition of interchange freight cars.

Government Regulatory Requirement Mechanical requirements placed on freight cars by various government agencies.

Governor Device to automatically start and stop the air compressor and regulate the main reservoir pressure.

Governor (Air Brake) See Air Compressor Governor.

Governor (Locomotive) A device which controls the speed of the diesel engine and load in accordance with the throttle setting. Governor controls may be effected by electro-hydraulic, electro-pneumatic, pneumatic-hydraulic means or by mechanical linkage.

Grab Iron See Handhold.

Grade The rise or fall in elevation of railroad track. A rise of 1 foot in elevation in 100' of track is a 1% ascending grade. Similarly, a decrease of 0.75' or 9" in elevation in 100' of track is a 0.75% descending grade.

Grade Brake, Effective Where the brake has been applied for three minutes with the retainer in horizontal position and the operating (triple, control, etc.) valve in release position; there will be a discharge of air at the retainer exhaust when its handle is moved to down position.

Grade Braking (Heavy) Where retaining valves must be used to hold the brakes applied while the brake equipment is being recharged on a descending grade.

Grade Drag The resistance to motion of a train on a gradient due to the pull of gravity, divided by the weight of the train. Grade drag is always 20 pounds per ton for each percent of grade. Thus, a train on a .75% grade (.75 feet or nine inches change in elevation per 100 feet of length of track) would have 15 pounds per ton grade drag. If the track rises, the grade drag is positive; if the track decreases in elevation, the grade is negative. See Grade and Grade Resistance.

Grade Resistance The resistance to motion of a train on a gradient due to the pull of gravity. Grade resistance is always 20 pounds for each ton of train weight for each percent of grade. Thus, a train on a 0.75 per cent grade (.75 feet or nine inches change in elevation per 100 feet of length of track) would have 15 pounds grade resistance for each ton of train weight. If the track rises, the grade drag is positive; if the track decreases in elevation, the grade is negative.

Gradient The difference in pounds per square inch between brake pipe pressure on the locomotive and maximum obtainable on the rear of the train. The direct result of brake pipe leakage.

Graduated Release A feature whereby the pressure in all of the brake cylinders of a connected brake equipment may be reduced in steps.

Graduated Spring A form of compound spring in which only a certain number of the individual spirals come into action with a light load and the others only under a heavy load. Graduated springs have been superseded by single and double nest coil springs of equal length.

Graduating Valve In air brake valves, a small slide valve fastened to the piston stem and sliding on the top of the main slide valve. It opens and closes ports in the slide valve which control the flow of air from the auxiliary reservoir to the brake cylinder in service applications, from the brake cylinder to the atmosphere in release, and also controls the quick service and quick recharge features.

Grain Door A temporary arrangement for sealing the openings around boxcar sliding doors so that the car may be used for bulk handling of grain. One common type consists of heavy reinforced paper nailed to strips of wood which are fastened to the door posts one either side of the car door opening.

Grain Line A line marked on cars to indicate loading height for various grains.

Grain Loading The rate at which particles are emitted from a pollution source. Measurement is made by the number of grains per cubic foot of gas emitted.

Grain Strip A strip of wood or other material used to prevent leakage of grain from freight cars.

Grating A flat car surface formed by welding thin steel strips on edge in a crisscross grid pattern which permits water drainage while forming a solid support for the foot. Grating sections are used for end platforms,

brake steps, running boards and other applications to improve safety while walking or standing on equipment.

Grates The area in the index where cars are unloaded.

Gravity Switch Move A switching maneuver whereby gravity causes a stationary car to roll when the handbrake is released rather than being propelled by an engine.

Grids Resistances introduced in electric circuits to convert electrical energy into heat, thereby controlling the current in the circuit.

Grievance Arbitration The process of resolving a labor dispute involving the application interpretation of a collective bargaining agreement, by asking an impartial third party to make a decision after both labor and management have presented their cases.

Grille A fine grating made of wire mesh or other similar material for covering openings in air ducts, or to provide protection around machinery.

GRL Gross Rail Load. See Gross Weight.

Groove A channel usually cut by a tool. Grooves usually connect the two sides of a piston in certain positions. Annular groove is a ring-shaped channel or opening.

Groove Weld A type of weld where the metal deposit fills a groove prepared in advance to facilitate making the joint.

Gross Program Car requirement (pool operation). Individual railroad total car requirements for a specific pool.

Gross Weight The total combined weight of the car and its contents. Truck capacity determines the maximum allowable gross rail weight. The maximum GRL for a car equipped with 100 ton trucks is 263,000 pounds. See Light Weight and Load Limit.

Ground An electrical connection, whether intentional or accidental, between the positive side of an electric circuit and the earth, or some conducting object that serves in its plane, such as a locomotive underframe.

Ground Relay A protective device that functions to prevent operations of a locomotive in the event of a short circuit or ground in the electrical equipment. This is done to ensure the safety of the crew on the locomotive and to prevent damaging the locomotive itself.

Guide Rails Longitudinal members extending along the deck of a flatcar to restrain lateral movement and guide the wheels of automotive vehicles while moving during loading and unloading operations.

Gun Iron A tough, close-grained and strong cast iron, made of special mixtures, including steel scrap. Used for piston rings and parts requiring strength or subjected to wear.

Gusset Plate A flat steel plate used to reinforce a joint between two members in a steel structure.

H

HSC (High-Speed Control) A general name given to brakes having D-22 and D-24 type control valve.

Half Oval A term used to describe a specific elliptical cross sectional shape of an exteriorly mounted heater coil as differentiated from a channel section.

Hand Brake (1) A device mounted on railway cars and locomotives to provide a means for applying brakes manually without air pressure. Common types include vertical wheel, horizontal wheel and levertype, so named because of the configuration or orientation of their operating handles. (2) The brake apparatus used to manually apply or release the brakes on a car or locomotive.

Hand Brake Chain The chain which forms part of the connection between the hand brake shaft and the brake levers.

Hand Brake Chain Carrier A guide for the hand brake chain, riveted to the underframe.

Hand Brake Connections The rods and chains connecting the hand brake shaft with the brake levers.

Hand Brake Housing An enclosure containing the gearing and release mechanism of a hand brake.

Hand Brake Pawl See Brake Pawl.

Hand Brake Wheel A steel hand wheel, approximately 14 inches in diameter, attached to the brake shaft to provide a means for manually applying the brakes.

Hand Car A four-wheeled car used in connection with track inspection and repair work by maintenance employees for transporting men, tools, etc. Most hand cars are powered by gasoline or electricity instead of manually.

Hand Rail Post A support for the hand rail.

Hand Truck A small, rectangular barrow with a pair of handles at one end, a pair of small, heavy wheels at the other, and a projecting edge to slide under a load.

Handhold (Safety Appliance) A round steel bar of ¾" minimum diameter, formed with a means for mechanical attachment to a car side, end or roof, to provide a secure place holds are considered "safety appliances" by the FRA, and as such, are subject to very strict regulations with respect to placement and clearances. Also known as "grab irons."

Handhole A small opening in a crankcase, tank or other vessel usually provided with air and water tight seal which can be removed so that the hand may be inserted for making repairs or for other purposes.

Handling Line The railroad of record in the AAR Train II System having possession of an interchange freight car.

Handrail A bar or rail to be grasped with the hand.

Hanger Any component of a mechanical system that serves to support other components in the system by suspension. The use of the term hanger generally implies that the parts are suspended at pinned connections, and are free to move as the mechanism may require.

Hanger Link See Swing Hanger.

Hanger Pull Pull on the brake hanger as the result of the friction between the brake shoe and the wheel.

Hard Conversions When products are hard converted, the design of the item in SI metric units result in a physical change and the product is not interchangeable with earlier products built to conventional unit design.

Harmonious Hand and Air Brake A foundation brake gear in which the forces of the hand brake and the air brake are exerted in the same direction.

Harsh Slack Action A change of train slack that is likely to cause damage to equipment or lading.

Hasp A slotted bar that fits over a U-shaped staple forming a connection that can be secured with a pin or wedge driven through the staple in front of the hasp.

Hatch The opening through which products are loaded in covered hopper cars.

Hatch Cover The hinged door that closes and seals a hatch on the roof of a covered hopper car.

Hazardous Material (1) When used with respect to lading in transportation vehicles, a term identifying the lading as subject to specific safety requirements set forth by the Department of Transportation and/or the Interstate Commerce Commission. Examples of hazardous materials are explosives, poisons, flammable liquids, corrosive substances, and oxidizing or radioactive materials. (2) A substance or material which is capable of posing an unreasonable risk to health, safety, and the environment.

H-Beam A wide flange rolled structural beam having a cross section similar to the letter "H".

HD Acronym for "Hot Dog" which refers to a stub sill design tank car (without a continuous center sill).

Head Plate Refers to the flat plate that will subsequently be formed into a tank head.

Head Shield A supplemental heavy steel plate required by federal regulation on the ends of some hazardous commodity tank cars to lessen the chances of tank head puncture by the coupler of an adjacent car in the event of excessive end impact or derailment. Head shields can be either "full" (covering the entire end of the tank) or "partial" (covering only the lower portion of the tank head).

Head Shoe The structural reinforcement between the draft sill and tank head at each end of a tank car.

Header A lateral or circumferential heater coil that connects two (2) or more parallel longitudinal heater coil runs.

Header Heater System A heater system embodying a series of parallel heater coil runs, half oval in section and welded to the exterior of the tank shell. All runs are connected to a common header at either end and the middle and extend through the bolsters to a point beyond the tank head seams.

Header System A tank car heater arrangement generally consisting of 4 or more parallel longitudinal heater coil runs connected together at each end of the tank by headers. Normally used only with steam.

Headway Time interval between vehicles moving in the same direction on a particular route.

Heat Balance A tabulation showing the heat developed by combustion in the engine cylinder that is: delivered in the form of power at the crankshaft; lost in friction; lost to the cooling water; and lost in the exhaust gases.

Heat-Treated Heating and cooling a metal or alloy in such a way as to obtain desired conditions or properties. Heating for the sole purpose of hot working is excluded from the meaning of this definition.

Heat Treatment The process of altering the properties of a material, usually steel, by specific heating and cooling operations.

Heater Car A car equipped with heating apparatus for carrying fruit, vegetables and other products during cold weather. Also, a car fitted with a steam generator for heating of passenger trains.

Heater Coils The half oval heat chamber sections generally running the length of the tank which are welded to the exterior of the tank.

Heater Piped Car A tank car equipped with either exterior or interior heater coils in which steam is applied at an unloading point to facilitate the liquefying of viscous or semi-solid lading thus permitting normal unloading. This type of tank car is referred to as an HP car or an IHP car if it is insulated.

Heater Pipe Inlets and Outlets Fittings at either end of a heater pipe system. Steam is applied at the inlet and escapes through the outlet as a combination of steam and condensate.

Heater Pipes The 2 inch diameter pipe sections that generally run the length of the tank and which are mounted to brackets inside of the tank.

Heater Runs One generally straight continuous longitudinal section of heater coil or heater pipe.

Heating Treating Wheels are moved by conveyor to a rotary hearth normalizing furnace where they are treated.

Heavy Rail See Rail, Heavy.

Heavy Repairs As reported to the Association of American Railroads, repairs to revenue freight cars requiring over 20 man-hours.

Heavyweight Car A car generally constructed before 1931 and built on the principle where the frame and side sills act in a box form, the sides being supported by vertical members for strength.

Held for Orders Cars in repair facilities waiting on authorization to proceed with repairs.

Helical Spring A spring made of bar steel wound in a coil to form a helix. Standard truck springs are helical springs, but are more commonly known as "coil springs."

Helper Locomotive A locomotive usually placed towards the rear of a train, to assist in the movement of the train over heavy grades. Helper locomotives can be either manned, or remotely controlled from the lead unit in the train.

Hi-Cube Car A term used to describe any of a series of boxcars whole inside dimensions are such as to produce a cubic capacity of approximately 10,00 cubic feet, as opposed to the cube of conventional cars, which is usually in the range of 4,000 to 6,000 cubic feet.

Hi-Hat A term used to identify that portion of the draft gear housing on low level piggyback and autorack flatcars that extends above the deck of the car. Also, the configuration of the upper surface of one design of plain journal bearing.

High and Wide A term referring to outside dimensions of a car or open top load that exceed the normal clearances on the route to be traveled.

High Occupancy Vehicle (HOV) Vehicles that can carry two or more persons. Examples of high occupancy vehicles are a bus, vanpool and carpool. These vehicles sometimes have exclusive traffic lanes called "HOV lanes," "busways," "transitways" or "commuter lanes."

High-Pressure Emergency A feature in passenger brakes obtained through having an emergency reservoir and cutting out the safety valve.

High Side Gondola Car A gondola car, with sides and ends over 36 inches high, for carrying coal or minerals.

High Speed Brake (1) A name given to practically every new passenger brake developed. (2) An air brake designed so that a greater pressure is applied to the wheels when traveling at a high speed than at a low speed.

High Speed Rail See Rail, High Speed.

High-Speed Reducing Valve A device connected to the brake cylinder on passenger brakes to start a gradual reduction of brake cylinder pressure at high speeds, the reduction increasing until a certain pressure (60 pounds) is reached when the reduction is stopped.

Highway Trust Fund The federal trust fund established by the Highway Revenue Act of 1956; this fund has two accounts–the Highway Account and the Mass Transit Account. Trust fund revenues are derived from federal highway user taxes and fees such as motor fuel taxes, trust fund uses and expenditures are determined by law.

Hinge A joint between two members so constructed as to allow one or both of the members to pivot upon a common axis. The axis is generally a pin passing through a series of cylindrical eyes fastened to each member and brought into a common alignment.

Hinge Pin The bolt or pin about which the two members of a hinged joint pivot.

Hi-Rail (Noun) A truck or automobile with retractable flanged wheels so it may be used on either highway or track. Also called "hi-railer."

Hold Track A track in a storage yard where cars are held, awaiting disposition orders by consignees or owners.

Hollow Rod The piston rod of a standard freight car brake cylinder, so named because it is made hollow to receive the cylinder push rod.

Home Line/Home Road The road which owns the car or upon which the home of a private car is designated or located.

Home Point A specified location on a railroad which, by agreement, is considered as a home junction for cars belonging to non-railroad private car owners.

Home Shop A repair facility designated by the car owner.

Hook and Eye Brake A term used to describe a foundation brake arrangement where certain brake levers are formed with a hook at one end that connects to an eye welded to the end of the mating brake rod. This arrangement replaces the conventional clevis and pin connection. The arrangement was developed to accommodate close clearance conditions between the truck and body bolsters on freight cars with large center plates and sliding sill cushioning. The concept has subsequently spread to other types of cars, and the arrangement is becoming more common.

Hook Bolt A bolt having a hook-shaped end instead of the conventional head.

Hopper Car A freight car, either open or covered, designed for handling bulk commodities such as coal or grain. Hopper cars have floor sheets that slope from the car sides and ends to form a series of pockets, or hoppers, which when opened, can discharge the bulk lading by gravity through hopper doors operated from outside the car.

Hopper Chain See Drop Door Chain.

Hopper Door A door at the bottom of the hopper on hopper cars which when opened permits rapid discharge of bulk lading either between or outside of the rails depending on the typed of door design. Hopper doors on covered hopper cars are often known as "discharge gates."

Hopper Door Frame The frame, often made in one piece, fastened to the slope and hopper sheets which forms a closing edge for the hopper door.

Hopper Door Hinge The movable fastening or support upon which a hopper door swings.

Hopper Door Locking Pawl In a hopper door gear, the catch, which when thrown into engagement with the toggle arms, prevents the arms from moving from the closed position and opening the hopper doors.

Hopper Door Toggle Arm The link in a drop door mechanism which is fastened to the door and forces it shut when the toggle link is forced down.

Hopper Door Toggle Link The arm in a drop door mechanism which forces down the toggle arms when the winding shaft is revolved and closes the door.

Hopper Slope Sheet A metal sheet used in the sloped floor of a hopper car.

Hopper Support An angle, riveted to the ridge of the hopper at the center and the top of the side sheet, forming a support for the hopper.

Horizontal Wheel Hand Brake A type hand brake incorporating a vertical brake staff and a horizontally mounted brake wheel as opposed to a vertically mounted geared hand brake or a side mounted brake with a pump type handle.

Horsepower Limited Speed The maximum speed obtainable from the horsepower developed by the locomotive.

Hose Tubing made of rubber and canvas or other flexible materials, used to convey a fluid, generally over relatively short distances. See Air Hose.

Hose Clamp A clamp or collar to bind the hose to the hose nipple of coupling. Sometimes called a "hose band."

Hose Coupling A standard fitting with which hose can be coupled to air pipes of cars and locomotives for continuous flow of air between them. See Glad Hand.

Hose Nipple A short iron tube fitting into the end of the air brake hose and fastened by a suitable clamp. One end is threaded and screws into the angle cock.

Hose Protector A device to protect the air brake, signal or steam heat hose from damage. See Armored Hose.

Hostler's Control A simplified throttle provided to move a diesel locomotive unit not equipped with a regular engineer's control.

Hot Box Railroad slang for an overheated journal bearing.

Hot Box Detector A heat sensitive device installed along railroad mainline track at strategic locations for measuring the relative temperatures of passing journal bearings. Bearing temperatures are transited to wayside stations and are monitored by personnel who can act to stop a train if an overheated journal is discovered. Some hot box detectors will automatically drop the next block signal to a stop indication if an overheated condition is noted, thus, stopping the train to allow for an inspection.

Housing A term frequently applied to any part which encases some or all of the working parts of a machine.

Hub The central portion of a wheel into which the axle is fitted.

Hub Cutting An oxypropane hub cutting torch automatically cuts out the hub of the wheel.

Huck Bolt A mechanical fastener similar to a nut and bolt, except the nut is replaced by a collar that is permanently deformed into the grooves on the bolt at application.

Huddle Chamber The configuration of the valve body seat and the immediately adjacent downstream parts that redirect the flow of the effluent, causing a popping action by lifting the valve stem.

Hump Yard A railroad classification yard in which the classification of cars is accomplished by pushing them over a summit, known as a "hump," beyond which they run by gravity.

Hydraulic Jack A jack in which the power is exerted by means of the pressure of some liquid acting against a piston or plunger. See Jack.

Hydropneumatic Brake A braking system for railroad cars that utilizes compressed air to control the action of a hydraulic piston that ultimately applies braking force to the wheels. Braking control can be transmitted from car to car in the conventional way, while the advantages of hydraulics can be employed to actually apply the brakes without the rigging problems inherent in conventional foundation gear.

Hydrotest The water pressure test that each tank is subjected to when built and at other specific times during its life, as specified by the AAR.

I

I-Beam A general term applied to any form of rolled steel having a cross section the shape of a capital "I".

IBV Acronym for an "internal bottom ball valve." This is an angle style valve whose body and inlet opening extend into the tank. See Bottom Outlet Valve, Ball Valve, Angle Valve.

ICC Abbreviation for Interstate Commerce Commission.

Icing Placing ice in bunkers of a refrigerator car prior to and/or during transportation for the purpose of preserving commodities requiring protection against heat.

ID A term used when referring to inside diameter of a cylinder or any circular surface such as the bore of a railway car wheel.

Idle The speed at which an engine runs when it is not under load.

Idler Car Usually a flatcar used in the transportation of a long article or shipment, which extends beyond the limits of the car carrying the shipment; the "idler" being a car on which the shipment or article does not rest, but overhangs.

IDP (Independent Distributed Power) Allows locomotives not connected directly in consist to be controlled by the lead unit as they were connected for multiple unit operation.

IDT Initials that stand for "in-date-test," a former periodic test of the air brake equipment on every car to assure its continued proper operation. Periodic in-date-tests are no longer required, but a similar single car test must be completed when specific defects exist on a car.

Ignition The burning of fuel oil within the combustion chamber of a cylinder. In a diesel engine, this is accomplished by compressing the air in each cylinder, with the heat of compression being sufficient to ignite the fuel.

Ignitron High voltage, high current mercury vapor (pool-type) rectifier which is gated by a pulse applied to its starting electrode (ignitor). Ignitron rectifiers were used in some electric locomotives.

Impact Goggles Safety eyewear that meets ANSI Z87.1 specifications.

Impact Tests A standard series of controlled and instrumented test couplings of cars at increasingly higher speeds to determine the effect of switching impacts on the car frame structure and lading with respect to various draft arrangements on the cars under test.

Improvised Created out of the conditions or materials at hand.

Inboard Bearing Bearing mounted on axle inside of the wheel.

Incident An undesired event that, under slightly different circumstances, could have results in personal harm or property damage. Any undesired loss or resources. Sometimes referred to as a "near miss," such as when a collision is avoided.

Inclined Plane A railway operating over exclusive right-of-way on steep grades with unpowered vehicles propelled by moving cables attached to the vehicles and powered by engines or motors at a central location not onboard the vehicle.

Incoming Brake Test made by many railroads on arrival of freight trains at a terminal to determine condition of brakes and other items.

Independent Brake The air brake control valve on a locomotive unit that controls the brakes on that locomotive (or multiple unit consist) independently from the train brakes.The train brake is also called the "automatic brake."

Independent Brake Valve A device used for applying and releasing the locomotive brake regardless of the train brake.

Independent Pressure Switch A device installed on a locomotive that will automatically cut-on the extended range dynamic braking when

an independent brake application of sufficient magnitude is made, usually 15 psi. This is to prevent the wheels of the locomotive from sliding due to excessive braking forces.

Industrial Car A railway car used primarily in intraplant service for moving such material as steel billets, hot metal, sand or other rough commodities. Industrial cars are not suitable for interchange service and are exempt from provisions of the FRA safety standards.

Inertia A term used in the study of physics to describe the natural tendency of a body to maintain its existing velocity.

Inert Retarder A device or system for holding a classified cut of cars and preventing it from rolling out the bottom of a railyard.

Inflatable Bulkhead A special type of load divider consisting of two or three vertical bulkheads separated by inflatable air bags that can expand and exert a controlled longitudinal force against the lading, thus preventing undesired movement during transit. See Load Divider.

Initial Terminal The starting point of a locomotive for a trip.

Injector The pump and nozzle used to force fuel oil into a cylinder under great pressure.

Inlet Valve A check valve used in a compressor, permitting air flow into air cylinder from the atmosphere but preventing it from returning to atmosphere when being compressed.

Innage A measurement of the number of gallons of commodity contained in a tank. Usually determined indirectly by measuring to the liquid level in the tank and them consulting a precalculated table.

Inshot Provision for controlling a portion of flowing air.

Inshot Valve Used to cause a measure flow of air for part of an operation.

Inspect To examine officially in a critical, detailed manner.

Inspection Car A car used for inspecting track and right-of-way.

Inspector A person authorized by the tank owner, or when not authorized by the owner, designated by the tank fabricator or car builder, to perform inspection.

Instruction Car A car used for the instruction of railway employees in matters pertaining to their work.

Instrument Panel The board upon which various gages are mounted, electrical, air, oil, etc.

Insulated Refers to a tank, fitting, housing, draft sill, or other car appurtenance whose outside surfaces are covered with a thermal insulating material.

Insulation (Car Construction) In general, any material that serves to decrease the flow of heat through a structural wall from one space to another. Common insulating materials in rail car applications include polyurethane foam and fiber glass, both used in refrigerator cars. Dead air space between wall panels also serves as effective insulation.

Intake That portion of a pipe or other apparatus through which water, air, or other fluid enters from the source of supply.

Intake Valve A check valve used in a compressor, permitting air flow into air cylinder from the atmosphere but preventing it from returning to atmosphere when being compressed.

Intelligent Vehicle Highway Systems (IVHS) Automated systems of highway transportation designed to improve traffic monitoring and management. IVHS includes: Advanced Public Transportation System (APTS), Automatic Vehicle Location System (AVLS) and "smart vehicles" which assist drivers with planning, perception, analysis and decision making. See also Intelligent Vehicle Highway Society of America (IVHS America).

Intercepting Valve Used in universal valves to hold back the emergency reservoir air from flowing into the brake cylinders during emergency position until the service reservoir has equalized with the brake cylinder.

Inter-Terminal Switching An interchange of cars, the movement of which is confined to the switching limits of the same station or switching district.

Interchange (1) The operation of cars owned by parties other than the railroad on which it is operating. Handling, inspection, and repair of cars while operating in interchange are controlled by the AAR Interchange Rules. All parties owning and operating freight cars agree to be governed by the Interchange Rules. The rules are established and maintained by committees made up of representatives of railroad and car owners. If offered in interchange, a car complying with all interchange requirements must be accepted by an operating railroad. (2) The transfer of cars from one road to another at a common junction point.

Interchange Acceptance A freight car is considered interchanged when accepted by the receiving subscriber or if possession is so indicated in the AAR Train II System.

Interchange Point The geographical point, yard, junction, or track common to two railroads where cars are routinely interchanged from one railroad to another.

Interchange Rules (1) A set of regulations adopted by the Association of American Railroads governing the care and handling of freight cars operating in interchange service. The Interchange Rules are contained in two publications known as the Field Manual and the Office Manual, and are revised and reissued annually to meet changing conditions. (2) Technical requirements governing the interchangeability, safety and strength of railroad cars and their components. By reference to various AAR specifications, the Interchange Rules enforce requirements for the design and construction of freight cars. The Interchange Rules also establish the criteria for determining whether a car or component needs to be repaired or replaced, how the repair is to be performed, and what the cost of that repair is to be.

Intercooler A heat exchanger interposed between the low pressure and high-pressure stages of the air compressor. By reducing the temperature of the air at the intake of the high-pressure stage the volumetric efficiency of the compressor is improved.

Interest Arbitration The process of arriving at the terms of a new collective bargaining agreement, by asking an impartial third party to make rulings after both labor and management have presented their cases.

Interior Heater A term used to describe any of several tank car heating systems using pipes or coils mounted on the inside of the tank and in direct contact with the fluid to be heated. See Exterior Heater Pipes.

Interior Lining Any sheet or laminated type material, glass or fused metal applied to the interior of tank car tank to act as a barrier between the base metal and commodity.

Interior Prep The blasting and/or grinding of the interior surfaces of a tank or covered hopper car usually in anticipation of lining or coating application.

Interlock Electrical contacts mounted on other contactors, unit switches or the reverser so that they are opened or closed as the contactor, unit switch or reverser operates. Closing the main contacts may either open or close the interlock contacts and vice versa.

Interlocker In railroad terms is a point on the line where one or more routes converge or cross, requiring that signals displayed to trains are interlocked to avoid conflicts in the movement of trains using those routes.

Intermediate Discharge Valve A check valve used in compound compressors permitting air to flow from the low to the high-pressure air cylinder but not the reverse.

Intermediate Line A railroad which is neither the delivering nor originating carrier for a freight car. For billing purposes a subscriber which is neither the car owner not the responsible party.

Intermediate Sill The longitudinal members of an underframe between the side sills and the center sills.

Intermodal Those issues or activities which involve or affect more than one mode of transportation, including transportation connections choices, cooperation and coordination of various modes. Also known as "multimodal."

Intermodal Car A rail car designed specifically for handling piggyback trailers or containers, or both. Intermodal cars may be long flatcars with collapsible trailer hitches, or shorter, lightweight platforms with rigid hitches for use at mechanized terminals. Some newer designs are articulated, and have as many as ten platforms connected t form one "car."

Intermodal Surface Transportation Efficiency Act (ISTEA) The 1991 law that reauthorized the federal surface transportation program

for six years. ISTEA heralded a new era in surface transportation because of the emphasis on "intermodalism," the unprecedented increases in authorized spending for transit (and vice versa) and the increased reliance on regional planning agencies to weigh transportation options and make decisions utilizing public participation.

Intermodal Traffic Freight moving via at least two different modes of transport (i.e., highway and rail or water and rail).

Internal Ball Valve A bottom outlet valve normally mounted from the outside of the tank car tank and protruding into the tank area in order to provide the lowest possible profile protruding below the tank.

Internal Combustion Engine An engine in which power is obtained by the combustion of a gaseous or liquid fuel in a series of cylinders.

Internal Screw Gage A solid steel cylinder with a screw thread on it for testing the diameter of female threads.

Inter-Terminal Switching An interchange of cars, the movement of which is confined to the switching limits of the same station or switching district.

Intra-Plant Switching The movement of cars from one place to another within the limits of a terminal on the same transportation line.

Isolation Switch An electrical device in a diesel electric locomotive which disconnects the controls of the locomotive from the cab control circuits. The switch must be in the "RUN" position in order for the unit to develop power.

IXC Acronym for an insulated and exterior coiled tank car.

J

Jack A mechanical device for lifting heavy objects by applying the required force from beneath the object. The necessary force is commonly obtained either by a long lever arm (with a ratchet arrangement), by a screw or with air or hydraulic pressure.

Jack Bolt A bolt with a forked end instead of the conventional head.

Jacket A thin outer shell over a tank or pipe, often made of sheet metal, and used to contain insulating material wrapped around the pipe or tank.

Jacket Spacer On insulated cars, any one of the numerous steel, foam, or wood spacers that are mounted between the tank and the jacket thus defining a uniform space for the insulation.

Jacking Pads Heavy steel pads attached to car side sills at each corner near the bolster, and designed to support the weight of the car on jacks.

Jacking Plate A plate commonly applied to a steel side sill to protect it from damage when the car is being jacked.

Jackknife A term used to describe an extremely adverse condition existing between two rail vehicles (or a highway tractor and its trailer) whereby excessive sharp angularity occurs at the pivoting connection between the two units, resulting in severe misalignment of the connection, and generally, in the case of rail cars, a derailment. Jackknifing is caused by excessively high buff forces in a train.

Jaw A forked attachment used for making a pivotal connection. Also, the part of a wrench, vise, or other holding mechanism that contacts the piece or pieces to be clamped.

Jitney Privately owned, small or medium-sized vehicle usually operated on a fixed route but not on a fixed schedule.

Job Code A four digit number that identifies the inspection, repair, and/or testing performed, or the car component applied or removed.

Job Safety Briefing A communication tool used by professionals to make sure that everyone involved in a task knows what is to be done, how the task is to be accomplished, and how to mentally prepare to accomplish it. Job safety briefings must be conducted before beginning work activities and whenever there is a change in conditions or work activity.

Joint The junction of members or the edges of members that are to be joined or have been joined.

Joint Development Ventures undertaken by the public and private sectors for development of land around transit stations or stops.

Joint Inspection Certificate (JIC) A document detailing unfair usage damage or loss or extensive owner's defects as outlined in Rules 95 and 108. See Rule 103 of the Field Manual of The AAR Interchange Rules.

Joint Root The portion of a joint to be welded where the members approach closest to each other. In cross section, the joint root may be either a point, a line, or an area.

Journal That part of an axle or shaft on which the journal bearing rests or a roller bearing is applied.

Journal Bearing The general term used to describe the load bearing arrangement at the ends of each axle of a railcar truck. So called plain journal bearings are blocks of metal, usually brass or bronze, shaped to fit the curved surface of the axle journal, and resting directly upon it with lubrication provided by free oil contained in the journal box. Journal roller bearings are sealed assemblies of rollers, races, cups and cones pressed onto axle journals and generally lubricated with grease. Vertical loads are transferred from the journal bearing to the truck side frame through the journal bearing wedge (in plain bearing designs), or through the roller bearing adaptor in roller bearing trucks.

Journal Bearing Wedge A device used to hold the journal bearing in place in the journal box and to distribute the load evenly over the bearing.

Journal Box The metal housing on a plain bearing truck which encloses the journal of a car axle, the journal bearing and wedge, and which holds the oil and lubricating device.

Journal Box Lid A door or lid covering an opening in the journal box through which oil is added, the lubricator is inspected and serviced, and journal bearings are inserted or removed. Journal box lids are generally held closed by a strong spring.

Journal Box Seals Devices for retaining oil and excluding water and solid contaminants from plain bearing journal assemblies. This involves a rear seal which fits in the dust guard well of the truck side frame and a front seal which fits around the edges of the journal box lid.

Journal Brass Another term sometimes used when referring to a plain journal bearing.

Journal Jack A small jack used for relieving the weight from car journals for the purpose of changing bearings.

Journal Lubricator A device installed in a journal box that enables oil in the box to be evenly distributed to the bearing surfaces of the axle journal and the journal bearing for efficient lubrication of the assembly.

Journal Spring A spring supporting part of the weight of a car which is placed directly over the journal, and which usually rests on the journal box under the truck frame.

Journal Stops Metal castings, usually of bronze, fastened to the inside of the journal box which limit movement of the axle journal, particularly during switching impacts and brake applications.

Jumbo Pressure Car Generally refers to pressure cars in excess of 30,000 gallons capacity.

Jumper A flexible cable, composed of one or more independently insulated conductors and fitted with plugs at each end to allow for connection of electric circuits between coupled locomotives or cars.

Jump Seat An additional seat in the cab of a car of locomotive which may be folded up when not in use.

Junction A point at which two or more carriers interchange freight. Also, a point where two lines of a railroad meet, usually with provision for operating trains from one line to the other.

Junction Box In electrical circuits, a metal housing placed in a convenient location for the purpose of gaining access to otherwise concealed wiring, and providing protection for electrical connections made between conductors in the circuit.

K

Keeper A mechanical device whose function is either to prevent undesired movement of some other component, or to prevent the accidental disengagement of a lock or bolt.

Key A mechanical device, which in various ways can be used to maintain a fixed relationship between two components in an assembly.

Key Bolt A bolt slotted near the end to receive a key which takes the place of a nut.

Key Slot The slot or slots in the coupler butt and draft sills through which the draft key is inserted.

Keyway A machined slot in a shaft or in the hub of a wheel, the purpose of which is to accept a machined steel bar or key which is driven into the keyway to prevent undesired rotating of the shaft relative to the wheel.

Kicker A slang term used by operating crews to describe a freight car whose air brake equipment is malfunctioning to produce undesired emergency brake applications in a train.

Kinetic Energy A term used in the study of physics to describe the energy contained in a moving body by virtue of its motion. The kinetic energy of a moving body is equal to the energy needed to bring it to rest.

Kinetic Friction Friction obtained by making two pieces of material very nearly flat and then rubbing them together until they conform to each other's surface so that air will not pass between them. Slide valves and rotary valves are lapped to their seats so that air under pressure will not leak from one port to another.

Kingpin On a highway semi-trailer, the short flanged steel pin projecting downward from the front load bearing surface of the underframe, which is grasped by the tractor in highway operation, or by the trailer hitch when the trailer is being transported on a piggyback flatcar.

Kiss and Ride A place where commuters are driven and dropped off at a station to board a public transportation vehicle.

Kitchen Car A car provided with cooking facilities but with no provision for table service. Usually operated next to a dining car.

Knee Brace A stiffening piece used to reinforce two members of a structure that meet at right angles.

Knuckle (1) The pivoting casting that fits into the head of a coupler to engage a mating coupler. (2) The pivoting hook-like casting that fits into the head of a coupler and rotates about a vertical pin to either the open position (to engage a mating coupler) or to the closed position (when fully engaged). Coupler knuckles must conform to a standard dimensional contour specified by the Association of American Railroads.

Knuckle Pin The steel pin holding the knuckle in the head of the coupler. The knuckle pin is sometimes known as the "knuckle pivot pin" or simply "the pivot pin."

Knuckle Thrower A device that serves to open the coupler knuckler when the uncoupling lever is operated.

KVA An electrical term relating to kilowatt voltage/amperage.

L

"L" Side That side of a rail car on the left side of the observer when facing the "B" end of the car.

Ladder Bars of iron or steel attached by bolts or rivets to the side or end of a freight car or caboose so as to form steps by which persons may climb to and from the car. The individual bars are termed "ladder rounds."

Ladder Assemblies Attached by bolts or rivets to the side or end of a freight car so as to form steps by which a person may climb to and from the car. The individual bars are termed "ladder treads." A typical freight car ladder consists of vertical stiles with a number of horizontal treads.

Ladder Bolt A bolt designed especially for securing the ladder rounds at the corner post when two rounds are directly in line on the side and end of the car.

Lading Another term for the load in a rail car.

Lading Strap Anchors Tie down devices welded to structural members of a freight car and designed to accept steel banding or wire used to secure loads in or on the car.

Lag Screw A metal bolt with a square or hexagonal head but with a wood screw thread; intended to screw into wood or other soft material.

Lands The portions of the piston between the grooves carrying the piston rings.

Lap A surface defect on metal appearing as a seam caused from folding over hot metal, fins, or sharp corners and then rolling or forging.

Lap Fit The fit obtained by making two pieces of material very nearly flat and then rubbing them together until they conform to each other's surface so that air will not pass between them. Slide valves and rotary valves are lapped to their seats so that air under pressure will not leak from one port to another.

Lap Fit Piston Where a piston ring is not used and a slight amount of air may pass the piston; it is made close-fitting and lapped with very fine grinding material into the cylinder until, even though close-fitting it is made a sliding fit.

Lap Joint In welding processes, any joint formed by two overlapping members.

Lap Position Where ports are closed from effective operations.

Lap Weld In welding processes, any joint formed by two overlapping members.

Lateral Motion Sideways movement of a railcar and/or its components, resulting in large measure from dimensional clearances between parts of the truck assembly. Excessive lateral motion in truck assemblies is a major cause of premature wear of the truck and carbody components.

Layover Time Time built into a schedule between arrival at the end of a route and the departure for the return trip, used for the recovery of delays and preparation for the return trip.

Layshaft A shaft extending the length of a locomotive diesel engine on both sides used to control fuel injection in each cylinder of the engine.

LCL Initials meaning "less than carload" to describe a freight moving quantities of less than a carload.

Leading Foot Foot farthest away from the approaching equipment as you face the track.

Lead Locomotive Locomotive from which the operator controls the entire train.

Lead Unit The first and controlling unit in a locomotive consist.

Leakage Groove A small short passage past the brake piston to prevent application of the brakes by a small leakage of air.

Leased Car A car rented by a shipper or a carrier for a through movement.

Length Over Pulling Faces The effective coupled length of a railcar.

Length Over Strikers The distance between the outer faces of the strikers of a railcar.

Length Over Truck Centers The distance between the truck center pins. Sometimes referred to as truck centers.

Lessee An individual or a corporation who has the right of use of something of value, gained through a lease agreement with the real owner of the property. Very often railroads lease car equipment from financial institutions, and this fact may be indicated on the car by stenciling, naming the owner and identifying the railroad as the lessee.

Level Playing Field A balance approach to federal funding proportions for highway projects and transit projects; may also refer to employee transportation benefits so that the monthly, tax-free value of a transit pass is equal to that of a parking space; generally, any situation in which transit and highways receive equal treatment in federal funding and other federal procedures.

Lever One of the basic groups of simple machines consisting of a bar of rigid material used in conjunction with a support called a fulcrum. Depending on the placement of the fulcrum, the lever can be used either to: increase applied force at the expense of speed; increase speed at the expense of force; change the direction of an applied force; or to effect a combination of these advantages. The most familiar example of the lever in car construction is found in the foundation brake gear. See Brake Lever.

Lever Guide A support and guide for a brake lever in the brake lever in the brake rigging.

Leverage The system of levers used to increase the delivered braking force from the brake cylinder to the brake shoes, discs, etc.

Leverage Ratio The change of force from the brake cylinder to the frictional surfaces, as brake shoes, discs, etc.

Light Rail Passenger equipment employed in some form of commuter service and not built to the heavier standards of other passenger cars which are based on the FRA and Amtrak rules.

Light Rail See Rail, Light.

Light Repairs As reported to the Association of American Railroads, repairs to revenue freight cars requiring 20 man-hours or less.

Light Weight Empty weight or tare weight (of cars or of the train). The empty weight of a railroad car or of train including its trucks and any other appurtenances considered standard to the car. The light weight is stenciled on every freight car in conjunction with the capacity and load limit stenciling, and is abbreviated Lt. Wt.

Lightning Arrester A device for protecting electrical apparatus from damage by lightning by providing a path to ground around the protected equipment.

Lightweight Car A car generally constructed after 1931 and employing a design incorporating the side sheets into the car strength.

Limit Gage A term applied to many forms of gages which are used for determining whether pieces exceed or fall below a certain specified range of dimensions. Limit gages are sometimes called "Go-No-Go" gages.

Limiting Valve A device to restrict as to time, pressure, or both, the operation of another device of function.

Line Haul The movement over the tracks of a carrier from one city to another, not including the switching service.

Liner (Diesel Engine) The removable inner sleeve of the engine cylinder which contacts the piston rings.

Lining As used in boxcar construction, a thin sheathing of wood or other material applied to the inside walls and ends of closed type cars to provide a smooth obstruction-free interior for loading. As used in tank or covered hopper car construction, a chemical coating usually in liquid form that is sprayed or foamed onto the interior surfaces of the carbody to impart some desirable property to the surfaces in contact with the lading.

Link and Pin Coupler An old type of connection between cars which employed a link and a pin arrangement.

Liquefied Natural Gas (LNG) An alternative fuel; a natural gas cooled to below its boiling point of -260 degrees Fahrenheit so that it becomes a liquid; stored in vacuum bottle-type container at very low temperatures and under moderate pressure. LNG vapor is lighter than air.

Liquid Tight A valve, tank, or mechanical joint judged to have passed a specific hydrostatic leak test utilizing specific acceptance criteria.

Liquid Valve Normally refers to the top unloading valve mounted at the top of a education (siphon) pipe.

Live Lever Any lever in the foundation or truck brake rigging that does not have a fixed (non-movable) connection.

Live Load In car design, the live load is the load imposed on the car structure by outside forces such as the lading and any other specified supplemental loads such as accelerations due to vertical irregularities in the track structure. See Dead Load.

Live Truck Lever Part of the foundation brake rigging connected to the rod receiving its force from the brake cylinder.

Load Brake Cylinder The brake cylinder of the empty-and-load freight brake equipment that operates to increase the braking force only when the car is loaded.

Load Compensating Varying the braking force in proportion to the load.

Load Divider A device installed in a closed car for the purpose of providing restraint against undesired longitudinal movement of the lading. Load dividers are generally used in pairs, and are adjustable to allow for tight placement against the lading in each end of the car.

Load Factor The ratio of passengers actually carried versus the total passenger capacity of a vehicle.

Load Limit The maximum weight of lading that can be loaded in a car. For cars meeting standard AAR design criteria, the load limit is equal to the maximum allowable gross weight on rails (determined by axle and wheel size) less the light weight of the car. Load limit is stenciled on every freight car in conjunction with the capacity and light weight stenciling and is abbreviated LD. LMT.

Load Meter The ammeter at the engineman's control stand used to indicate the amount of current passing through the traction motors.

Load Regulator (or Load Pot) A potentiometer or rheostat hydraulically positioned by the locomotive governor which controls the load on the traction generator.

Loading Allowance Job Code 4486 as defined in Rule 75, AAR Field Manual, or the amount of compensation allowed for loading damage equipment onto other equipment.

Lock Any device the formation of which is to secure other adjacent or connecting parts in a fixed position.

Lock Bolt A fastener used in car construction which is formed into a cold rivet by mechanical force.

Lock Lifter See Coupler Lock Lifter.

Lock Nut A special type of nut having a feature which prevents the nut from turning off the bolt once it is secured. Lock nuts are not reusable since their removal generally destroys the locking feature.

Lock Washer A washer designed to prevent undesired loosening of a nut after it has been tightened.

Locking Center Pin A center pin so made as to provide a positive non-separable connection between the carbody and truck center plates.

Lockout/Tagout (LOTO) Procedures that involve tagging and locking systems so that no one can inadvertently activate the circuit, system, or equipment that is temporarily out of service.

Locomotive One or more locomotive units under the control of a single operator. Sometimes referred to as locomotive consist. Thus, the locomotive consists of locomotive units connected for multiple unit operation. A self-propelled, non-revenue rail vehicle designed to convert electrical or mechanical energy into tractive effort to haul railway cars. See Locomotive Unit.

Locomotive Brake The independent brake. This brake may be applied and released independently of the train brake.

Locomotive Cab (1) That portion of the superstructure designed to be occupied by the crew while operating the locomotive. (2) The compartment of a locomotive from which the propelling power and power brakes of the train are manually controlled.

Locomotive, Caboose or Passenger Car, Rebuilt A locomotive, caboose or passenger car that has undergone overhaul which has been identified by the railroad as a capital expense under (ICC) Interstate Commerce Commission accounting standards.

Locomotive, Control Cab A locomotive arranged as having the only controls over all electrical, mechanical and pneumatic functions for one or more locomotives, including controls transmitted by radio signals if so equipped. It does not include two or more locomotives coupled in multiple which can be moved from more than one set of locomotive controls.

Locomotive Crane A power-operated crane, usually of the jib type, equipped to run on rails under its own power. The crane is erected on a special type of carbody including propelling apparatus so that the power equipment which operates the lift can also be connected to the wheels. See Wrecking Crane.

Locomotive, Dead (1) A locomotive other than a control cab locomotive that does not have any traction device supplying tractive power; or (2) a control cab locomotive that has a locked and unoccupied cab.

Locomotive, Designated Service Exclusive operation of a locomotive under the following conditions; (1) The locomotive is not used as an independent unit or the controlling unit is a consist of locomotives except when moving for the purpose of servicing or repair within a single yard area; (2) The locomotive is not occupied by operating or deadhead crews outside a single yard area, and (3) The locomotive is stenciled; Designated Service-DO NOT OCCUPY.

Locomotive Fueling Station A facility alongside a track, usually in a rail yard, for the purpose of fueling a railroad locomotive.

Locomotive, Lite A locomotive or consist of locomotives not attached to any piece of equipment or attached only to a caboose.

Locomotive, MU A multiple-unit operated electric locomotive.

Locomotive Trip A movement of a locomotive over all or any portion of automatic train stop, train control or cab signal territory between the terminals for the locomotive; a movement in one direction.

Locomotive Truck The assembly of parts comprising the structure which supports each end of the locomotive superstructure or body and consisting of the traction motors, wheel and axle assemblies and air brake cylinders.

Locomotive Unit A single carbody with power and transmission equipment, but not necessarily with the controls. Also called a "power unit," or, in the case of diesel-electric locomotives, a "Diesel Unit." The least number of self-propelled machines running on rails which convert energy into motion for the purpose of pulling or pushing on a train. A locomotive is made up of one or more locomotive units.

Locomotive, Yard A locomotive that is operated only to perform switching functions within a single yard area.

Logging Car A special type of car for hauling or carrying logs usually consisting of two trucks and a skeleton frame, but sometimes provided with machinery and power for hauling by means of a cable.

Logging Truck A truck used in logging cars. The member corresponding to the body bolster in other types of trucks is called a "bunk" and is so arranged that timber or logs may be chained in place on it.

Long Ton A long or gross ton consists of 2,240 lbs.

Low-Level Car A flat car with the deck lowered approximately 10 inches from that of a standard-level car. Such cars have a depressed center sill behind the coupler and draft gear housing and have trucks using 28-inch wheels. Originally developed to permit trailers to be carried on eastern routes with very tight clearances, low-level cars are now used primarily for tri-level auto racks.

Low Level (Flatcar) Referring to the height of a TOFC or auto rack flatcar deck above the top of the rail. Low level cars have a deck height of 31½" as opposed to a 41½" height for "standard level" cars.

Low Profile Ball Valve A bottom outlet valve designed to protrude a minimum distance below the tank shell. Normally extending into the outlet saddle.

Low Side Gondola A gondola car with sides and ends no more than 36 inches high.

Lt. Wt. Abbreviation for light weight.

Lubricant Any liquid or grease employed to coat a surface upon which another surface rotates or slides in order to reduce the friction.

Lubricating Oil System The complete system on a Diesel electric locomotive for providing lubricating oil to the working parts of the engine.

Lubricator A device (mechanical or hydrostatic) used to supply oil to parts of the compressor and compressor governor under pressure.

Lug Any projection on a component designed to afford a bearing surface or a point of securement to some other part. See Draft Lug.

L/V Ratio The L/V ratio is defined as the ratio of the lateral force to the vertical force of a car or locomotive wheel on a rail. It is an important factor affecting the tendency to turn over under load, and is often a point of discussion in evaluating the cause of a train derailment.

M

Magnet Bracket An electro-pneumatic device that, in response to the application and release circuits that are closed and opened through its application and release magnet valves, applies and releases the electro-pneumatic brake.

Magnet Valves An electro-pneumatic device, the valves of which, through energizing and de-energizing, are opened or closed to cause flow of air from supply to operating device or from operating device to the exhaust.

Magnetic Float Gauge Usually a closed system gauging device that utilizes magnets to couple a liquid float to a visually observed gauge rod. See B-612 Magnetic Gauging Device and Gauging Device.

Magnetic Levitation (Mag-Lev) A rail transportation system with exclusive right-of-way which is propelled along a fixed guideway system by the attraction or repulsion of magnets on the rails and under the rail cars.

Magnetic Particle Testing A non-destructive test method for identifying cracks or discontinuities in castings or machined parts.

Magnetic Speed Indicator A small magneto generator, driven from an axle, which shows on a dial in the cab the speed at any moment by the voltage developed at the terminals of the magneto.

Magneto A small generator using permanent magnets for field poles.

Main Reservoir A cylindrical tank, carried on a locomotive or motor car, to hold a supply of compressed air. So called in distinction from the auxiliary and emergency reservoirs under each car.

Main Reservoir Release Where air at main reservoir pressure is supplied into the brake pipe for releasing and recharging the brakes.

Main Steam Valve Used in a steam compressor to distribute the steam to and from the steam cylinders.

Maintain To ensure the continuing existence of a railcar in a certain condition. See Poor Condition, Fair Condition, Good Condition, First Class Condition.

Maintaining Supplying air to keep proper pressure where the pressure, through use or leaks of air, is tending to reduce.

Maintaining Valve Used in equalizing piston valve portion on locomotive in connection with first service features to provide controlled reduction of brake pipe pressure where brake pipe leakage tends to cause more rapid drop than is desired.

Maintenance Advisory An informational notice issued by the AAR for interchange freight cars having minor mechanical defects or potential problems.

Major Modification This term is used to define modifications with respect to prevention of significant deterioration and New Source Review under the Clean Air Act and refers to modifications to major stationary sources of emissions and provides significant pollutant increase levels below which a modification is not considered major.

Major Stationary Sources Term used to determine the applicability of prevention of significant deterioration and new source regulations. In a non-attainment area, any stationary pollutant source that has a potential to emit more than 100 tons per year is considered a major stationary source. In PSD areas the cutoff level may be either 100 or 250 tons, depending upon the type of source.

Male Center Plate The carbody center plate with its protruding bowl is sometimes called the "male center plate" as distinguished from its mating truck bolster center plate which is known as the "female center plate," the names being taken from the configuration of the two components.

Malleable Iron Cast iron which has been heat-treated to improve the toughness while retaining a good degree of ductility.

Managers of Mobility Transit systems which expand their role to include services and approaches beyond traditional public transportation to include ridesharing, high occupancy vehicle programs, public education on transit's benefits and integration of land use, air quality and transportation decisions; the phrase was developed as part of the industry's Transit 2000 policy effort undertaken in the late 1980s and early 1990s.

Manifold A component of a piping system having multiple fittings allowing several lines to be connected to a common volume or supply, fed from or leading to a single line. Intake and exhaust manifolds on internal combustion engines are common examples. Certain locomotive air brake systems make use of a manifold for mounting brake equipment.

Manway An opening in the dome of a tank car which permits access to the car's interior for such purposes as cleaning, inspecting and making repairs.

Manway Cover The hinged and bolted, or totally bolted cover that seals the manway opening.

Manway Hinge A hinge by which a manway cover is attached to the manway ring.

Manway Ladder A ladder installed on some tank cars extending down into the tank under the manway to allow workman to descend for purposes of cleaning, inspection or repairs.

Manway Ladder Brace A metal piece attached to the inside of the tank and to the manway ladder to keep the ladder in a vertical position.

Manway Nozzle The cylindrical shape that is welded to the top of many tanks defining the manway opening and upon which the manway cover is mounted.

Marked Information applied to a car by either stencil or decal.

Marked Capacity The volumetric (gallons) shell full capacity stenciled on each end of a tank car.

Marker A device or devices used, on cars and or locomotives, by a railroad as required under its operating rules. A lamp, reflector or flag mounted on a suitable bracket usually at the upper left and right corners of locomotives and caboose cars to indicate the front and rear ends of a train. Rear end markers always show red to the rear. Head end markers, where used, generally are white (to designate the train as an extra) or green (to indicate that a second section of the same train is following behind).

Mass Transit Account The Federal account, established by the Surface Transportation Assistance Act of 1982, into which a designated portion of the federal Highway Trust Fund revenue from motor fuel taxes is placed (1.5 cents in 1994). This account is used for federal mass transportation assistance.

Mass Transit or Mass Transportation See Public Transportation.

Master Controller An electro-pneumatic device used on the locomotive to pneumatically open and close application and release circuits. This causes the operation of magnet valves throughout the train for electro-pneumatic application and release of the train brakes.

Maximum Gross Weight on Rails For a single car, the maximum permissible weight of both car and lading permitted for operation in unrestricted interchange service. This figure is determined for any car by established Association of American Railroads Standards, and is related to the size of the axle journal in the trucks, and the diameter of the wheels under the car. For cars meeting AAR design standards, the sum of the stenciled load limit and light weight will equal the maximum gross weight on rail allowed for that specific car.

Maximum Tractive Effort As applied to locomotive equipment, the maximum force that may be exerted at the rims of the driving wheels. See Tractive Effort.

Maximum Width The maximum railcar width as determined by the applicable clearance diagram.

Mean Distance Between Failures (MDBF) The average distance in miles that a transit vehicle travels before failure of a vital component forces removal of that vehicle from service.

Meat Rack (Refrigerator Car) The supports near the ceiling from which meat is suspended. Also called a "beef rail."

Mechanical Advisory An informational notice issued by the AAR covering interchange freight cars identified as unacceptable to an individual railroad for mechanical reasons.

Mechanical Aeration Use of mechanical energy to inject air into water to cause a waster stream to absorb oxygen.

Mechanical Designation An alphabetic code assigned by the Association of American Railroads to every freight car to designate its general design characteristics and its intended purpose. Mechanical designations are stenciled on every car on the same line and immediately to the right of the capacity stenciling.

Mechanical Inspection Department (MID) AAR inspectors authorized to conduct inspections and investigations to insure compliance with the Interchange Rules and the mandatory provisions of the Manual of Standards and Recommended Practices. See Rule 120 in the Field Manual Of The AAR Interchange Rules.

Mechanical Refrigerator A term applied to refrigerator cars equipped with a self-contained power plant and mechanical refrigeration equipment including a compressor, condenser, evaporator, and fans for distribution of cold air around the lading. The term is used to distinguish such cars from the older "ice" cars which relied on large blocks of ice placed in bunkers at the ends of the car to provide cooling.

Mediation Efforts by an impartial third party to encourage agreement between a labor union and management by counseling each side and facilitating negotiations. Also known as "conciliation."

Meter One of the standard length measurements in the metric system, equivalent to 39.368 inches in the English system.

Methanol An alternative fuel; a liquid alcohol fuel with vapor heavier than air; primarily produced from natural gas.

Metric System A decimal system for measuring length, capacity, surface and weight, using the meter as the unit of length, the liter as the unit of volume, and the gram as the unit of weight.

Metroliner High-speed multiple unit electric intercity passenger cars originally used on the electrified portion of the Northeast Corridor between New York City and Washington, DC. Metroliner service has been extended to Boston using coaches similar to the original Metroliners.

Metropolitan Planning Organization (MPO) The organization designated by local elected officials as being responsible for carrying out the urban transportation and other planning processes for an area.

Metropolitan Railway (Metro) See Rail, Heavy.

Microwave Gauging Device A closed gauging device utilizing microwave technology rather than mechanical floats, direct visual, ultrasonic, or other means to detect tank liquid level.

Middle Transom (Six-Wheel Trucks) The term applied to the two transoms nearest the center of the truck distinct from the two outside transoms.

Minimum Continuous Speed The minimum speed at which a locomotive can operate continuously under heavy load condition without damaging the traction motors from high current (amperage). This speed is based on the maximum amperage the traction motor can accept without overheating.

Minimum Thickness Thickness of material required by regulations and/or design of the car to safely transmit in-line train forces.

Mining Locomotive A small locomotive operated by propane, compressed air of electricity for hauling cars in mines.

Minority Business Enterprise (MBE) A business owned and operated by one or more individuals who are defined as minorities under US Department of Transportation regulations. See also Disadvantage Business Enterprise.

Mixed Train A railroad train consisting of both passenger and freight cars.

Mobile Source A moving producer of air pollution, mainly forms of transportation such as cars, trucks, motorcycles, airplanes.

Mobile Unit A crew that is qualified and equipped to travel to a particular location to make repairs without the car being shopped.

Modal Split A term which describes how many people use alternative forms of transportation. Frequently used to describe the percentage of people using private automobiles as opposed to the percentage using public transportation.

Mode An analytical tool (often mathematical) used by transportation planners to assist in making forecasts of land use, economic activity, travel activity and their effects on the quality of resources such as land, air and water.

Modification "Non-repair" or "non-maintenance" physical work performed upon a railcar.

Modular Construction performed in a unitized rather than custom fabricated manner.

Mold Preparation Both the cope and the drag are cleaned and prepared for the next pouring.

Monorail An electric railway in which a rail car or train of cars is suspended from or straddles a guideway formed by a single beam or rail. Most monorails are either heavy rail or automated guideway systems.

Motive Power A term relating to the self-propelling equipment of a railroad, usually taken to mean locomotives.

Motor Car A car propelled by some form of motor located on the car itself. Preferably called "rail motor car." The common types of motor cars are: electric, which are equipped with electric motors and receive current from either a third rail or trolley wire; and those propelled by internal combustion engines which may have either electric or fluid drive.

Motor (Electric) A machine for converting electrical energy into rotating mechanical energy in the form of rotary motion. It consists of a rotating armature turning in a magnetic field produced by an electric current. Motors for electric locomotives are built to operate on either alternating or direct current. Nearly all traction motors for diesel locomotives are series DC machines. (Slang) A locomotive unit.

Motor Generator Set An electric motor and an electric generator mechanically connected together. Their principal functions are for transforming electric currents of a given voltage to a higher or lower voltage, from direct to alternating current, from alternating to direct current or from one frequency to another on the locomotive. The set of machines is often referred to as an "M-G Set."

Motor Truck A powered truck under a rail motor car, MU car or locomotive.

Motor Vehicle A motor-driven conveyance not designed for operation on rails.

Movement, Switch-and-Lock A device, the complete operation of which performs the three functions of unlocking, operating and locking a switch, movable-point frog or derail.

Movements, Conflicting Movements over conflicting routes.

Movements, Facing The movement of a train over the points of a switch which face in a direction opposite to that in which the train is moving.

MPH Abbreviation for "miles per hour."

MSDS (Material Safety Data Sheet) A form on which chemical companies inform their customers about chemical product hazards and on which employers inform workers about the hazards of chemical products they may encounter in the course of their employment.

MSDS Sheets Material Safety Data Sheet required to be provided by chemical manufacturers and shippers to potential handlers and users of the products.

Mudguards (Tank Cars) Tank mounted metal shields which prevent mud from splashing off the car trucks onto the tank.

Muffler A device attached to the exhaust manifold of an internal combustion engine to deaden noise.

Multi-Level Car A term generally used to describe a long flatcar designed with an integral superstructure having one or more deck levels in addition to the main deck of the car, and fitted for the transportation of set up automobiles. See Bi-Level Car and Tri-Level Car.

Multi-Service Cars Gondola or hopper cars adapted for transportation of bulk commodities and having a provision for optional discharge of same to center or to both sides of the track.

Multi-Unit Tank Car Refers to tank cars built to DOT 106A specifications. Consisting of a series of small tanks designed to be removed from the car for filling and emptying, used for transporting liquids in bulk.

Multiple Electrodes The combination of two or more single or parallel electrode systems. Each of the components systems may have its own independent power source and its own electrode feeder.

Multiple Housing A term sometimes used to refer to the cover protecting the top unloading fittings on a general purpose tank car.

Multiple Unit A term referring to the practice of coupling two or more locomotives or electric passenger cars together with provision made to control the traction motors on all units from a single controller. Sometimes referred to as "MU." Also see EMU.

Multiple-Unit Cars A term referring to the practice of coupling two or more electrically operated passenger cars together with provision made to control the operation of the cars from a single controller. Sometimes referred to as "EMU".

Multiple-Wear Wheel A steel railway wheel made with sufficient original rim thickness to permit turning full flange and tread contours at least twice during the life of the wheel.

M/X Equipment Bucketwheels and transfer conveyors.

N

Nailable Steel Floor Flooring for box, gondola, and flatcars made of specially formed steel channel sections laid side by side generally across the car. The individual sections are kept a predetermined distance apart by spacer nubs embossed in the edges of the channels to enable nails to be driven into the grooves between adjacent sections. Blocking and bracing may thus be secured directly to the floor as with wooden flooring, but the advantages of steel are retained.

Narrow-Gauge Railroads built to less than the standard 4'81/2" between rails gauge.

National Environmental Policy Act of 1969 (NEPA) A comprehensive federal law requiring analysis of the environmental impacts of federal actions such as the approval of grants; also requiring preparation of an Environmental Impact Statement (EIS) for every major federal action significantly affecting the quality of the human environmental.

National Highway System (NHS) A proposed transportation system consisting of approximately 155,000 miles of highway in order to provide an interconnected system of principal arterial routes serving major population centers, major transportation facilities, major travel destinations, interstate and interregional travel and meeting national defense requirements. The NHS, defined in the Intermodal Surface Transportation Efficiency Act (ISTEA), is one component of the National Transportation System (NTS). See Intermodal Surface Transportation System (NTS).

National Transportation System (NTS) An intermodal system consisting of all forms of transportation in unified, interconnected manner to reduce energy consumption and air pollution while promoting economic development and supporting the Nation's preeminent position in international commerce. The NTS includes the National Highway System (NHS), public transportation and access to ports and airports.

NEC Northeast Corridor. A route that extends 456 miles, stretching from Washington to Boston.

Needle Valve An adjustable valve with a tapered point used in oil or air lines where fine regulation of the working fluid is required.

Nest Spring A helical spring with one or more coils of springs inside of it.

Net Force A force which causes an object such as a train to accelerate. Total force applied to the train less drag forces.

Net Weight The weight of only the contents of the car.

New Start Federal funding granted under Section 3(i) of the Federal Transit Act (formerly known as the Urban Mass Transportation Act). These discretionary funds are made available for construction of a new fixed guideway system or extension of any existing fixed guideway system, based on cost-effectiveness, alternatives analysis results and the degree of local financial commitment.

New Unit or **Newly Acquired Unit(s)** A unit having a completely new carbody and underframe, with individual components meeting the requirements as specified in Rule 88 of the Office Manual of the AAR Interchange Rules.

NFL Bearing A factory lubricated journal roller bearing assembly made with superior seals and requiring no field lubrication during its normal service life. NFL bearings can be identified by the absence of a grease fitting in the end cap.

NINC Acronym for a non-insulated and non-coiled tank car.

Nipple A short piece of pipe with pipe threads turned on one or both ends and used for making connections in piping systems. See Air Brake Hose Nipple.

Nitrogen Purge The process of replacing a portion of the atmosphere inside of a tank with dry nitrogen, mainly to minimize moisture and/or oxygen formation and/or the subsequent rusting of the tank interior prior to the loading.

Nominal Capacity The approximate load carrying capacity of a rail car to the nearest 1,000 pounds, based on car design, the size of the axle journals and the light weight of the car. The maximum nominal capacity that may be stenciled on a car is the next even 1,000 pounds equal to or below the stenciled load limit. Nominal capacity is stenciled on every freight car, and is designated CAPY. See Capacity.

Nominally As nearly as possible; adjusting the brake cylinder piston travel to nominally seven inches takes into consideration the fact that it may not be practical to adjust it to exactly seven inches.

Nonattainment Area Any geographic region of the United States that the US Environmental Protection Agency (EPA) has designated as not attaining the federal air quality standards for one or more air pollutants, such as ozone and carbon monoxide.

Non-Coiled Refers to a tank car that does not have heater coils.

Noncontrolled Emergency Where the controlled emergency feature has been nullified.

Nondelayed Emergency The original name for noncontrolled emergency.

Non-Insulated Normally refers to a tank car that does not have any ambient temperature insulation covering the tank.

Non-Piped Tank Car A tank car not equipped with heating coils or insulation. Sometimes referred to as an "NP car."

Non-Pressure Car A tank car built to DOT specifications 103, 104, 111 and 115. Reference 49 CFR Part 179. The test pressure for non-pressure tanks is either 100 psi or 60 psi.

Non-Pressure Head The closure for the end of the brake cylinder not subjected to air pressure. The non-pressure head is tapered in the direction of piston travel, and has an opening for the hollow rod.

Normalized A heat treating process mainly utilized to improve the properties of shell and head plate.

Normalizing A heat treatment process for iron based alloys resulting in controlled definite grain size, often done to relieve internal stresses or to impart the properties of strength and toughness.

Normally Aspirated (Internal Combution Engine) An engine that uses are at atmospheric pressure for combustion.

Normal Position The position that the various parts of a device assume when it is in the same position as it will be when installed but not charged with pressure other than atmospheric pressure.

Normalized A heat treating process mainly utilized to improve the properties of shell and head plate.

Normal Wear and Tear The affect of use on a railcar which does not result in the railcar deteriorating below good condition. See First Class and Good Condition.

Nosing A transverse, horizontal motion of a locomotive which exerts a lateral force on the supporting structure.

Nozzle Any device containing one or more small openings through which a fluid is ejected under pressure.

NTSB The National Transportation Safety Board, part of the US DOT, which investigates serious transportation accidents.

Nullifier A device used on automatic brake valves to prevent the handle from being moved to release (full release) position.

Nycopak A proprietary name for a truck mounted brake system in which the brake cylinder is made integral with the brake beam. Later versions use only one brake cylinder per truck and incorporate an automatic slack adjuster.

O

Obligation A federal budgetary term that refers to a binding agreement that will result in an outlay; an agreement by the federal government to pay for goods or services immediately or at some future time when the goods or services are delivered. Also known as a "commitment."

Obligation Limitation A federal budgetary term that refers to a limit placed in appropriations bills on the amount of federal assistance that may be obligated during a specified time period. It does not affect the scheduled apportionment or allocation of funds; it just controls the rate at which these funds may be used.

Observation Car A passenger train car equipped with an observation end with a portion of the car usually used as a buffet or lounge.

Obsolete Standard A specification, procedure, practice, definition, design, product or device which was previously designated as a Standard or Alternate Standard but which has been superseded, and which is restricted in interchange service subject to prescribed conditions.

Office Manual One of two manuals that together form the AAR Code of Interchange Rules governing the condition and repair of railway equipment used in interchange service. The Office Manual contains the pricing and billing information used for preparing bills for repair work done on foreign cars. See Field Manual of Interchange Rules.

Off-Peak Period Non-rush periods of the day when travel activity is generally lower and less transit service is scheduled. Also called "base period."

Off-Site Facility A hazardous waste treatment, storage or disposal area that is located at a place away from the generating site.

Ohm A unit of electric resistance. One ohm is equal to that resistance required to cause a one volt drop in potential when the current is one amp.

Ohmmeter An instrument for measuring resistance in ohms.

Oil Cooler A radiator or device made so that lubricating oil can be cooled after circulating through an internal combustion engine.

Oil Pan In internal combustion engines, a reservoir for lubricating oil, usually in the base of the engine.

Oil Ring A ring located at the lower part of a piston to prevent an excess amount of oil from being drawn up onto the piston during the suction stroke.

One Spot A car or locomotive repair shop designed so that the units of rail equipment to be repaired are moved progressively through the shop to various positions where specified work is done. Rip tracks designed with a single repair position equipped with modern jacking equipment air, oxygen, and acetylene lines, lifting devices, and other time-saving equipment are sometimes referred to as "spot shops," or "one spots."

One-Wear Wheel A steel railway wheel designed with a rim thickness such that full flange and tread contour can not be restored by turning. See Multiple Wear Wheel.

On-Site Facility A hazardous waste treatment, storage or disposal area that is located on the generating site.

Open Air Distribution Air distribution for refrigerator cars in which the tempered air is directed through the lading. This method is used primarily for fresh produce.

Open Dump An uncovered site used for disposal of waste without environmental controls. See Dump Car.

Open-Top Car Any of a group of cars with or without sides and ends, and with no roof, all being intended for transportation of commodities not requiring protection from the weather, such as steel products, coal or rough forest products. Flat, gondola and hopper cars are all classed as open top cars.

Open-Top Loading Rules A set of standard rules and regulations issued by the Association of American Railroads governing the methods used for loading and securing commodities on open-top cars.

Operating Assistance Financial assistance for transit operating expenses (not capital costs); such aid may originate with federal, local or state governments.

Operating Deficit The sum of all operating expenses minus operating revenues.

Operating Efficiency Ton miles of train moved (or passenger miles) divided by fuel used.

Operating Expense Monies paid in salaries, wages, materials, supplies and equipment in order to maintain equipment and buildings, operate vehicles, rent equipment and facilities and settle claims.

Operating Platform An arrangement around the manway on tank cars, built to provide a flat surface and safety railing for workers involved in loading and/or unloading operations on top of the tank.

Operating Revenue Receipts derived from or for the operation of transit service, including fare box revenue, revenue from advertising, interest and charter bus service and operating assistance from governments.

Operating Valve The devices with which the brake is charged, applied, and released, such as triple valve, AB valve, distributing valve, control valve, etc.

Operation by Agreement Railroad equipment which has not received any form of approval by the AAR can still be operated if the individual railroads over which it operates agree to do so. Prior to controlled interchange, this was the only way that equipment such as double-stack cars could be operated.

Operator The person who "runs" and so must maintain control of any locomotive, piece of mechanized equipment, or motor vehicle.

Opposed-Piston Engine A diesel engine, with two pistons per cylinder, traveling away from each other during the power stroke and toward each other during the compression stroke. There are two crankshafts, connected through a bevel-geared shaft at right angles to the crankshaft.

Ore Car An open top gondola or hopper car designed specifically to carry iron or some other metallic ore. Because of the high density of most ores, cars for this service are built with relatively low cubic capacities, and some are equipped with empty-and-load brake equipment.

Orifice A specific size opening through which air or fluid may flow.

Original Cost Original ledger value of original owner or acquisition cost for cars purchased prior to January 1, 1973. See UMLER Specification Manual.

Original Record of Repairs The written record of repairs made to a foreign railroad car on a railroad rip track, and prepared at the time the repairs are performed. The original record of repairs becomes the basis for billing the car owner for repairs according to standards prescribed in the Interchange Rules.

OSHA Occupational Safety and Health Association.

Outage Tables Pre-calculated tables showing outages at various liquid levels.

Outage A measurement of the number of gallons of commodity left unfilled, or removed from a full tank. Usually determined indirectly by measuring to the liquid level in the tank and then consulting a precalculated table.

Outboard Bearing A bearing mounted on the axle outside of the wheel.

Outfall The place where an effluent is discharged into receiving waters.

Outlay A federal budgetary term that refers to a payment made to meet an obligation; the point at which an actual payment of money is made.

Outlet Valve (Tank Car) The valve on a tank car by means of which the lading is discharged from the tank.

Outrigger Heavy beams, with jack screws at the ends, which are put out on each side of a steam shovel or a locomotive crane at the forward bolster and supported on blocking. They prevent the carbody from overturning due to the reaction of the load on the boom.

Outside Sills The side sills of a car frame.

Overcast A regulating device which allows pressure to increase above that for which it is adjusted.

Overcharge (Air Brake) A condition where the brake equipment on the train has been charged to a pressure greater than the pressure that can be normally supplied from the controlling locomotive.

Overfire Air Air forced into the top of an incinerator or boiler to fan the flames.

Overhang That portion of the body of a railway car between the body bolster and the end sill. Long cars with large overhangs require special wide mouth striker openings to accommodate the lateral swing of the long shank couplers that must be used.

Overhead Contact Shoe A metal bar for collecting current from an overhead conductor along which it slides. It is held in place by a pantograph or bow.

Overhead Loading A method of loading highway trailers or containers on intermodal cars by the use of an overhead (usually a gantry type) crane. See Circus Loading and Side Loading.

Overland Flow A land application technique that cleanses waste water by allowing it to flow over a sloped surface. As the water flows over the surface, the contaminants are removed and the water is collected at the bottom of the slope for reuse.

Overload A load greater than that which a device is designed to carry.

Overspeed When the maximum authorized speed limit is exceeded.

Overspeed Control A safety device that will cause a penalty brake application to occur when the speed of a locomotive exceeds that of the overspeed setting.

Overspeed Protection A device to automatically shut down an engine on a locomotive if the engine speed exceeds a predetermined value.

Over-Reduction A brake pipe reduction exceeding the pressure at which the reservoir and the cylinder equalize.

Ovom A bottom outlet plug valve whose operating shaft extends to the top of the car thereby removing the unloader from a position under the car.

Ownership Plate A casting or stencil giving the name of the bank or trust company that furnished the funds to build the equipment and in whom ownership of the equipment resides.

Owner's Responsibility Inspection, defects, damage or loss assigned to the car owner in the rules of the AAR Field Manual.

P

Pacing Control of train speed through control of the throttle, using a reduction in throttle position when possible, to achieve a desired average train speed and schedule.

Packed Tower A pollution control device that forces dirty air through a tower packed with crushed rock or wood chips while liquid is sprayed over the packing material. The pollutants in the air stream either dissolve or chemically react with the liquid.

Packing A general term denoting the various substances and devices used to prevent leakage of fluids or gases through openings which cannot be closed by ordinary contact of the parts concerned. This definition should not be confused with journal box packing which really functions as a form of lubricator.

Packing Cup A specially designed packing component that fits on the base of the piston of the AB brake cylinder and presses against the cylinder walls to seal against air leakage during brake applications.

PACM (Potential Asbestos-Containing Material) Any material with potential-not-yet-confirmed of holding asbestos. Contact Industrial Hygiene or proper authority for guidance on confirming content of material.

Pad On a tank, a plate contoured and welded directly to the tank surface upon which another structural appurtenance is attached.

Panel A board or support for electric switches and other apparatus.

Pantograph A device for collecting current from an over headed conductor (catenary) and consisting of a jointed frame operated by springs or compressed air, and having a suitable collector at the top.

Parallel (Electric Circuit) A method of connecting two or more pieces of electrical apparatus of a common circuit so that the positive poles of each are connected to a common positive conductor and the negative poles are connected to a common negative conductor. See Series.

Parallel Electrode Two electrodes connected electrically in parallel and exclusively to the same power source. Both electrodes are usually fed by means of a single electrode feeder. Welding current, when specified, is the total for the two electrodes.

Paratransit Comparable transportation service required by the Americans with Disabilities Act (ADA) of 1990 for individuals with disabilities who are unable to use fixed-route transportation system.

Park and Ride Lot Designated parking areas for automobile drivers who then board transit vehicles from these locations.

Parlor Car A passenger train car for day travel, having revolving or movable seats, smoking compartments, and other amenities not found in coaches. An extra fare is generally charged for travel.

Particle Release Causing the brake cylinder pressure to be reduced, but leaving some effective pressure for braking.

Partial Service Application Reducing the brake pipe pressure at a service rate but not enough to cause equalization between the reservoir and the cylinder, or something less than a full service reduction or application.

Particulate Trap A filter which removes a portion of the particulates (solids, soot, etc.) from a vehicle's exhaust stream and generally includes a regenerative unit and associated control system to burn the collected solids.

Passage A channel or way through a valve, seat, or casting, etc., connecting ports, through which air may flow.

Passenger Car A unit of rolling equipment intended to provide transportation for members of the general public and includes self-propelled cars designed to carry baggage, mail, express and passengers.

Passenger Miles The total number of miles traveled by passengers on transit vehicles; determined by multiplying the number of unlinked passenger trips times the average length of their trips.

Passenger Transport (PT) The weekly newspaper of the transit industry that is published by the American Public Transit Association (APTA).

Patch Plate A steel plate applied as an overlay in a corroded area on an AAR tank or other repair fractures in a tank shell.

Pawl (1) A pivoted tongue or sliding bolt on one part of a machine that is adapted to fall into notches or interdental spaces on another part so as to permit motion in only one direction. (2) A specially shaped pivoting steel piece arranged to fall into notches or teeth of a wheel as it rotates in one direction, thus restraining rotation of the wheel in the opposite direction. See Brake Pawl.

Payload Capacity The maximum number of gallons that can be legally loaded into a tank car.

Peak/Base Ratio The number of vehicles operated in passenger service during the peak period divided by the number operated during the base period.

Peak Period Mourning and afternoon time periods when transit riding is heaviest.

Pedestal (Roller Bearing) That portion of a roller bearing truck side frame that takes the vertical load from the axle journals through the roller bearing adapters, and serves to retain the ends of the axle in the proper longitudinal relationship to the truck and to the rails.

Pedestal Spring A spring which rests on a journal box between the jaws of a pedestal.

Pedestal Stay Rod A transverse rod connecting the pedestal tie bars on each side of a truck to prevent them from spreading.

Pedestal Tie Bar A bar extending across the mouth of a pedestal jaw underneath a journal box and bolted to the jaws of the pedestal. Also, a bar sometimes called "pedestal strap," connecting two or more pedestals on the same side of a truck or car.

Pedestal Trucks Railway trucks designed with side frames having pedestals at each end to retain the journal bearings.

Penalty Applications An automatic application of air brakes caused by a locomotive overspeed or by the release of the safety control foot pedal with the locomotive brakes released.

Penalty Repair An improper or impermissible repair reported through an invalid applied/removed job code couplet.

Penalty Time A period of time controlled through design of the device preventing an operation for the sake of safety, such as releasing emergency applied brakes before a freight train is stopped.

Performance Control System A system which automatically controls the horsepower output of a locomotive during low speed operation to provide maximum tractive effort within the adhesion capabilities of the locomotive. This system also allows compatible operation with lower horsepower locomotives.

Permit An authorization, license, or equivalent control document issued by EPA or an approved state agency to implement the requirement of an environmental regulation; e.g., a permit to operate a waste water treatment plant or to operate a facility that may generate harmful emissions.

Phase Break A physical separation at the catenary wire, necessitated by the situation where electricity fed to the wire from one point along the line is not exactly in phase, not synchronized, with electricity fed to the line at a different point. A phase break deeps the two electrical currents separated. Change-over equipment permits the locomotive to be reconfigured internally to accept different voltage-frequency catenary supply during line-of-road operation, accomplished by the driver with the flip of a switch at the console.

Piggyback A term referring to the practice of transporting highway trailers on railroad flatcars. See TOFC.

Piggyback Cars Flatcars designed and equipped for the transportation of highway trailers. See Intermodal Car.

Pilot Cut-Off Valve A device to automatically suppress a safety control (dead-man) brake application when the brake cylinder pressure is a certain amount (usually about 30 to 35 pounds).

Pilot Valve A valve having small capacity and easily operated. Used to operate other devices or to make their operation easier.

Pinion The smallest of two gears in a gear chain.

Pipe Bracket That portion of an air brake control valve or other air brake apparatus which is secured to the car underframe, and to which pipe connections are made. The ABD pipe bracket is designed with two machined surfaces which exactly match the surfaces of the emergency and service portions of the equipment, so that these operating portions may be removed for periodic cleaning without disturbing the pipe connections to the valve.

Pipe Clamp A clamp for holding air or steam pipes in place, consisting of a fixed piece welded to the car underframe and a mating piece driven tight with a hammer when the pipe is in place.

Pipe Coupling A device by which two lengths of pipe may connected.

Pipe Friction The resistance to the flow of air through a pipe as a result of the tendency of the air to exert force in all directions.

Pipe Union A device by which two lengths of pipe may be connected without turning the pipe.

Piping Porosity Elongated porosity whose major dimension lies in a direction approximately normal to the weld surface. Piping porosity frequently is referred to as "pin holes" when the porosity extends to the weld surface.

Piston A disc or cylinder made to fit closely to the inside diameter of another cylinder, and having packing or rings to seal against leakage past its outer edges. When pressure is exerted on the face of the piston by a gas or other fluid, it moves within the cylinder, thus imparting linear motion to a piston rod attached to the center of the piston on the non-pressure side, and extending outside the cylinder.

Piston Face The side of the piston upon which the air first enters, such as the brake pipe side of an operating valve.

Piston Pin A pin which rests into bored holes in the piston and passes through the eye of the connecting rod, to join the two together flexibly. Also known as "wrist pin."

Piston Ring A metal ring that snaps into a groove around the circumference of a piston to prevent leakage of the working fluid between the piston and the walls of the cylinder.

Piston Rod A rod secured at one end to a piston, and extending outside the cylinder where it is connected to some mechanism to be operated by the compressed fluid within the cylinder. The piston rod in an air

brake system on a railway car is called the hollow rod, so named because it is a hollow rube into which the push rod fits.

Piston Stem A small shaft extending from the piston, with shoulders, and pins for holding valves in position so that their positioning will be controlled by movement of the piston.

Piston Travel The amount of linear movement of the air brake hollow rod or piston rod when forced outward by movement of the piston in the brake cylinder and limited by the brake shoes being forced against the wheel. Good brake efficiency depends on the slack in the brake system being maintained at a point where piston travel will not exceed a specified value, depending on foundation rigging design.

Pit A surface defect due to localized corrosion where the cavity diameter at the metal surface is equal to or less than the cavity depth.

Pits (Grouped) Adjacent pits that are separated by a distance less than two (2) times their average diameter. (Random). Adjacent pits that are separated by a distance greater than or equal to two (2) times their average diameter and do not exceed two (2) pits in any 6-inch (152 mm X 152 mm) area.

Pitting Localized corrosion.

Pivot Pin Another name for the knuckle pin in a coupler.

Placard Card Holder A steel frame designed to hold and display cards describing the nature of dangerous commodities being transported in a railway tank car.

Plain Bearing As distinguished from a journal roller bearing; a journal bearing arrangement whereby a brass or bronze bearing is held in place against a polished axle journal, and lubricated by free oil in a journal box fed to the bearing by a lubricating device.

Plate The term when used alone, means any flat piece of steel or other material having significant length, width and thickness, and suitable for construction purposes. A sheet is the same as a plate only thinner. There are many special car components, some flat and some formed, that carry the name "plate" as part of their identification; such as side plate, deck plate or end plate. See Wheel Plate.

Plate B, C, E, F and H An AAR clearance diagram for unlimited interchange. See Clearance Diagram.

Plate, Center See Center Plate.

Platform In the general sense, any raised or supported flat surface designed to serve some specific purpose. Usually an additional explanatory term is used with the word such as "end platform" or "brake platform" to more clearly identify the specific use.

Platform Casting (Car Construction) A steel casting which forms the frame of the platform and the underframe of the car back, to and including the body bolster, at which point it is secured to the structural steel underframe members.

Platform Grating A flat surface formed by welding thin strips on edge in a crisscross grid pattern or a formed surface which permits drainage while forming a solid support for the foot.

Platform Steps (Passenger Cars) The stairs at the corner of a car which afford the means of entering and exiting.

Platform Trap Door A door which covers the space over the steps, thus extending the platform out to the side of the car.

Plug In electrical work, the fixture attached to the end of a wire or cable to provide a means for connecting the cable to some device or to another cable. Male plugs have projecting prongs, while female plugs have slots or open clips to receive the prongs, and are sometimes called "receptacles." In pipe work, a plug is a small cylinder with external threads that can be screwed into the end of a pipe to seal the opening.

Plug Door (1) A type of side door used on insulated box and refrigerator cars that fits flush with the interior car side when closed. Plug doors provide a better seal and are, therefore, more desirable than the common sliding door for insulated car applications. 2) A freight car door designed to fit into the door opening rather than sliding across it.

Plug Valve A valve whose sealing member (plug) is raised and lowered against a seat to open or close the valve. May be handwheel or lever operated.

Plug Weld A circular weld made through a hole in one member of a lap or tee joint joining that member to the other.

Plume A visible or measurable discharge of a contaminant from a given point of origin. Can be visible or thermal in water, or visible in the air.

Plunger The piston in a high pressure pump such a fuel injector.

Plymetal A form of material used in passenger car interior construction which is composed of a plywood sheet covered on one or both sides with light metal.

Pneudyne Positioner A compressed-air-powered device remote controlled to position a piston accurately for clutch engagement and disengagement, and for reversing diesel engines, etc.

Pneumatic Having to do with air. Any system utilizing air for the force for operation.

Pneumatic Bulkhead A load securement device used in some boxcars, consisting of heavy inflatable air bags, sandwiched between two vertical bulkheads that exert longitudinal pressure against the lading when the air bags are pressurized. Lading is restrained from both lateral and longitudinal movement in transit by the force exerted by the bulkheads reacting at the ends of the car.

Pneumatic Foot Valve The foot operated air valve in a locomotive safety system sometimes known as the "deadman" valve. The valve must be continuously depressed while operating the locomotive. If the engineman releases the foot pedal, a warning whistle sounds, followed by a penalty brake application.

Pneumatic Switch An air-actuated device for shifting an electric current to another circuit or for opening and closing a circuit, etc.

Pneuphonic Horn One producing sound by means of air.

Pocket A term sometimes used to describe the space between the webs of a draft sill that contains the draft gear or end-of-car-cushioning unit. See Draft Gear Pocket.

Pool Cars Car operating pursuant to a car pooling agreement among and between railroads. See Car Pooling.

Pool (Pool Operation) A group of cars furnished by two or more carriers having the same characteristics and equipped with similar appurtenances which is assigned for the exclusive use of a specified shipper at a specified location or is in a national reload pool and requires consistent maintenance to the special appurtenances to be serviceable.

Poor Condition A railcar status denoting that the railcar is either unsafe seriously damaged, or cannot be placed in either interchange or revenue service.

Port An opening in a valve or cylinder for the passage of a fluid.

Port Alignment The relative position of various ports to each other and to the position of the controlling element, as in a brake valve or cock.

Position A place to which a valve piston, or other part will be located to cause or prevent the flow of air to or from desired locations.

Positioner A machine used to position cars over the grates in the index.

Post Any vertical member of a carbody super structure.

Post-Closure The time period following the shutdown of a waste management or manufacturing facility. For monitoring purposes, this is often considered to be thirty years.

Post Weld Heat Treatment Generally refers to the weldment (1,200ºF) and subsequent cooling for relieving weld induced stresses.

Pour Point The lowest temperature at which locomotive lubricating oil will barely flow measured under standard test conditions.

Power Work done by a force divided by the time required to do the work. A high power locomotive can do a relatively large amount of work in a short amount of time.

Power Brake A combination of parts operated by compressed air or force other than hand, controlled manually, pneumatically, or electrically, by means of which the motion of a train car or locomotive is retarded or stopped.

Power Braking A train handling technique whereby locomotive power is applied to a train to offset or partially offset the retarding force of an air brake application.

Power Plant Any independent system of machines used to generate electricity from some other form of energy, such as gasoline, fuel oil, coal, or flowing water. As applied to mechanical refrigeration systems

on rail cars, the power plant consists of a diesel or gasoline engine coupled to a generator, with all necessary controls.

PPE (Personal Protective Equipment) Any material or device worn to protect a person from exposure to or contact with any harmful substance or force.

Prereleasing Releasing the brake before or just as the train stops.

Pressure A unit force generally measured in terms of pounds per square inch (or kilograms per square centimeter) created by the action of a compressed gas or fluid in a confined space.

Pressure Car A tank car built to DOT specs 105, 109, 112 and 114. Reference 49 CFR Part 179 Subparts A, B, and C. Pressure cars have only one top nozzle which serves as a manway and upon which the fittings are mounted.

Pressure Chamber A reservoir used with distributing valves where air from the brake pipe is stored to provide the operation of the equalizing portion and air used in the application cylinder for automatic applications. The pressure chamber is similar in purpose to an auxiliary reservoir except that it does not supply air for the brake cylinders.

Pressure Differential Difference in pressure between some separating device, element, or orifice. For instance, if brake pipe pressure is 53 pounds and auxiliary reservoir is 50 pounds, there is a 3-pound pressure differential.

Pressure Head On a railway car brake cylinder, the closure over the end of the brake cylinder into which air pressure is admitted when the brakes are applied.

Pressure Maintaining Feature A feature of the air brake system on locomotives that serves to overcome normal train line leakage, and allows any desired brake pipe pressure to be maintained for long periods of time during service applications of the train air brake.

Pressure Pouring Station Where wheels are cast as controlled air pressure forces molten steel from ladle to the graphite mold in approximately 20 seconds.

Pressure Regulating Valve A device that may be adjusted to control and maintain a desired degree of pressure.

Pressure Retaining Valve A device connected to the exhaust that controls brake cylinder pressure so as to exhaust the air slowly and hold a certain amount while recharging the brake equipment during grade braking.

Pressure Regulator Any device is a system to regulate the pressure of a working fluid in the system.

Preventive Maintenance Inspection to discover if something needs repairing before it fails and performing the necessary work in order to stop or slow that failure.

Private Car Line A private concern owning its own rolling equipment or leasing cars to or from railroads and operating them as private cars.

Private Car Owner Any non-railroad owner of an interchange freight or passenger car.

Private Car (Passenger equipment) A business car assigned to specific official of a railroad for his personal use in conducting company business and making inspections. Freight equipment–any car operated in interchange, and owned by a shipper or some independent car leasing firm, as distinguished from a car owner by a railroad. A private freight car may usually be distinguished from a railroad owned car by the letter "X" used as the last letter in the car reporting marks.

Private Siding A side track owned or leased by an individual or a firm.

Procedure Qualification Record (PQR) A document providing the actual welding variables used to produce an acceptable procedure qualification test weld and the results of test conducted on the weld.

Process Weight Total weight of all materials, including fuel, used in a manufacturing process. It is used to calculate the allowable particulate emission rate from the process.

Propagation The passing from vehicle to vehicle through a train of a function or wave such as quick action, quick service.

Propagation Rate The speed with which an impulse passes through a train from car to car.

Propagation Time The time required for an operation to pass from one end of the train to the other.

Propane An alternative fuel; a liquid petroleum gas (LPG) which is stored under moderate pressure and with vapor heavier than air; produced as a by-product of natural gas and oil production. At remote locations not served by pipelines. It is usually shipped as a compressed liquid in heavy metal containers or in bulk in 33,000 gallon pressure tank cars.

Proper Authority (1) Those individuals who are qualified by virtue of their expertise or their position of leadership to approve, certify, or sanction. (2) Having secure approval for acting in a particular manner.

Protective Controls Controls which automatically function to protect the locomotive, its engine or the electrical equipment under abnormal conditions resulting from failures of various parts of the equipment to function correctly.

Protective Housing Generally refers to the heavy steel housing surrounding the fittings mounted on tank car manways.

PSI Abbreviation for "Pounds Per Square Inch".

Public Transit System An organization that provides transportation services owned, operated, or subsidized by any municipality, county, regional authority, state, or other governmental agency, including those operated or managed by a private management firm under contract to the government agency owner.

Public Transportation Transportation by bus, rail, or other conveyance, either publicly or privately owned, which provides to the public general or special service on a regular and continuing basis. Also known as "mass transportation," "mass transit" and "transit."

Pulley A wheel which usually has a grooved surface around the circumference, adapted to receive a cord, belt or chain which runs over it. Pulleys are used to transmit power, to change the direction of motion or, in a block and tackle arrangement, to enable the multiplication of force at the expense of speed. Another term often used for pulley is "sheave wheel."

Pull Iron A roping staple.

Pulsing A continuous operation of a valve either because of a malfunction or as an intended feature.

Pump Governor A device for regulating the pressure of fluid delivered by a pump by controlling the power delivered to the pump.

Pump Stage A term used in connection with centrifugal pumps to indicate the number of impellers, a single-stage pump having one impeller, a two stage pump two impellers, etc.

Purlin or Purline A longitudinal roof frame member extending over the carlines, to which the roof sheets are fastened.

Push Car A four-wheeled work car, designed to be pushed by hand; sometimes used as a trailer with a motor car, and supplied to maintenance employees for transporting materials too heavy to be carried on a hand car. See Hand Car.

Push Pole Pocket A semi-spherical cavity at the lower corners of older freight cars and locomotives (often a design feature of the corner casting) to enable a locomotive to push a car from a parallel track by use of a long pole inserted in the cavity. Safety considerations have made this practice obsolete, and newer cars are not equipped with push-pole pockets.

Push-Pull The operation of a passenger train consist which may be controlled from either the locomotive or a car at the opposite end of the consist. When in the "pull" mode, the locomotive is pulling, in "push" mode, the locomotive is pushing the consist.

Push Rod The rod which transmits force from the piston rod of a brake cylinder (the hollow rod) to the foundation brake gear on the car. The push rod fits loosely into the cylinder hollow rod and has a formed jaw on its outer end to enable a pin connection to be made to the cylinder lever. As brake cylinder pressure builds up, the collar of the hollow rod pushes against the back of the jaw on the push rod and forces it outward to apply the car brakes through the foundation rigging. Since the push rod is free to move within the hollow rod, a manual brake application can be made with the hand brake without the necessity of overcoming the frictional resistance of the brake cylinder piston.

PWHT Acronym for post weld heat treatment. See Post Weld Heat Treatment.

Q

Quadrant A notch circular part of a brake valve upon which the handle latch contacts. The depressions or notches indicate the positions as the handle is moved.

Qualified (1) The welder, welding operator or welding procedure qualification requirements of the AAR Manual of Standards and Recommended Practices, C-III, Appendix W have been met. (2) A person who, by possession of a recognized degree, certificate, or professional standing, or who by extensive knowledge, training, and experience, has successfully demonstrated his/her ability to solve or resolve problems relating to the subject matter, the work, or the project.

Qualifier Alpha or numeric code used to define the area where repairs were performed on a car or the manufactured/remanufactured component applied or removed from a car.

Quick Action The feature whereby the brake pipe reduction is increased and passes rapidly from car to car throughout the train.

Quick-Action Cylinder Cap Used with distributing valves so that brake pipe air is vented to brake cylinder when equalizing piston moves to emergency position. It is used to assist in the propagation of quick action.

Quick Recharge A feature incorporated in equipment having operating valves such as AB, D-22, etc., to provide a quick recharge of the auxiliary reservoirs from an emergency reservoir. Therefore, brake pipe pressure increases at a faster rate, as little air is taken from the brake pipe until the auxiliary reservoirs have been materially recharged and the brake released.

Quick-Release Valve A device located in the brake cylinder line of a locomotive brake to provide a fast local release.

Quick Service A term used to describe the initial stage of an air brake application on a freight car. During quick service, certain parts in the service portion of the control valve operate to create a local reduction in brake pipe pressure on each car to produce a rapid and positive brake application simultaneously throughout the train. This phase of brake application is sometimes referred to as "preliminary quick service."

Quick Service Limiting Valve A portion of an operating valve that nullifies quick service when the brake cylinder or displacement reservoir pressure reaches approximately 10 pounds.

Quick Service Valve A device to reduce brake pipe pressure and provide continuous quick service. That is, each brake pipe reduction will cause the quick-service valve to respond with a service reduction of the brake pipe.

R

"R" Side The side of a rail car on the right of the observer when facing the "B" end of the car.

R1 Form AAR forms used when repairs, alterations or conversions to a tank car are made using previously approved procedures and materials, must be submitted, by the company performing the work, to car owner, Bureau of Explosives and Secretary, Mechanical Division, AAR.

R2 Form AAR forms required for reporting: (A) Tank buckle repairs (B) Tank corrosion repairs (C) Tank crack repairs (D) Certain stub sill repairs (E) Stub sill, bolster and cradle pad connections to tank repairs. Reporting is the responsibility of the car owner and must be submitted by the car owner or the ccompany performing the work.

Raceway A channel or area provided in a vehicle in which electric wiring is placed.

Rack In machinery, a rectilinear sliding piece, with teeth cut on its edge for working with a gear wheel. In car construction, a supplementary structure on the basic carbody to facilitate the loading of specialized cargo.

Radius of Curvature A measure of the severity of a curve in a track structure based on the length of the radius of a circle that would be formed if the curve were continued. Freight cars designed to Association of American Railroads (AAR) standards must negotiate curves of stated minimum radii without wheel or truck interference with brake rigging or structural underframe members.

Radius of Vulnerable Zone The maximum distance from the point of release of a hazardous substance in which the airborne concentration could reach the level of concern under specified weather conditions.

Rail As used in car construction, any horizontal member of a car superstructure. The term is usually used in combination with some additional identifying word such as "belt rail" or "hand rail." As used in track, a rolled steel shape, commonly a T-section, designed to be laid end to end in two parallel lines on crossties or other suitable supports a form a track for railway rolling stock.

Rail, Commuter Railroad local and regional passenger train operations between a central city, its suburbs and/or another central city. It may be either locomotive-hauled or self-propelled, and is characterized by multi-trip tickets, specific station-to-station fares, railroad employment practices and usually only one or two stations in the central business district. Also known as "suburban rail."

Rail Diesel Car A self-propelled passenger car used in commuter or branch line service. RDC's have their own power plant, and can be operated in MU service with several cars controlled from the lead car.

Rail, Heavy An electric railway with the capacity for a "heavy volume" of traffic and characterized by exclusive rights-of-way, multi-car trains, high-speed and rapid acceleration, sophisticated signaling and high platform loading. Also known as "rapid rail," "subway," "elevated (railway)" or "metropolitan railway (metro)."

Rail, High-Speed A rail transportation system with exclusive right-of-way which serves densely traveled corridors at speeds of 124 miles per hour (200 km/h) and greater.

Rail, Light Transit type of equipment built to lighter than regular passenger AAR and FRA standards.

Rail Lubricator A device designed to apply grease to the gage side of the rail head at the beginning of a curve in order to minimize wear of the rail and wheel flange, or to eliminate noise.

Rail Modernization Federal funding granted under Section 3(h) of the Federal Transit Act (formerly known as the Urban Mass Transportation Act). These discretionary funds are distributed by a formula and made available to transit systems for improvements on fixed guideway systems that have been in service for at least seven years. Also known as "fixed guideway modernization."

Rail Pull The friction between the wheel and the rail that keeps the wheel from sliding, at the same time pulling on the rail.

Railroad All forms of non-highway ground transportation that run on rails or electromagnetic guideways, including (1) commuter or other short-haul rail passenger service in a metropolitan or suburban area, and (2) high-speed ground transportation systems that connect metropolitan area, without regard to whether they use new technologies not associated with traditional railroads. Such term does not include rapid transit operations within an urban area that are not connected to the railroad system of transportation.

Railroad Equipment Rail cars, locomotives, active retarders, and load cell test stands.

Railroad Fuel As relating to operation of the typical diesel electric locomotive, ASTM No. 2 diesel fuel.

Railroad, Light Density Railroads with 1200 or less train-miles per road mile.

Railroad Operation Any movement of train, engine, on-track equipment, or track motor car, single or in combination with other equipment, on the track of a railroad.

Railway Service Car A general term applied to cars used for maintenance of way, construction, wreck service etc. Including such cars as "ballast", "instructional", "scoop", "snow Plows", and "wrecking cars.".

Raised-Wheel Seat Axle See Axle.

Rapid Rail See Rail, Heavy.

Rapid Transit Rail or motorbus transit service operating completely separate from all modes of transportation on an exclusive right-of-way.

Ratchet A device having serrated teeth similar to sawteeth that works in conjunction with a pawl to prevent motion in one direction while allowing motion in the opposite direction.

Rate of Retardation Rate of speed reduction over a period of time. If the speed is reduced from 60 mph to 57 mph in 1 second the rate of retardation is 3 miles per second.

Rebuilt Unit An existing unit that has been recognized as rebuilt under the provisions of Office Manual 88. Units recognized by the Association of American Railroads (AAR) as being rebuilt shall be stenciled by owner "Rebuilt (month and year.)" A rebuilt unit does not meet all the requirements for a new unit and embodies other secondhand details not permitted for new units.

Receiving Line A subscriber accepting a freight car in interchange.

Receptacle In electrical system, a device for receiving a plug. Together the plug and receptacle allow for rapid and positive connection of cable having multiple conductors.

Recharge Replacement of compressed air that has been used.

Recommended Practice A specification, design, product or device which is accepted by the AAR for use on rolling stock. A recommended practice shall not substitute for a standard or alternative standard. (AAR)

Reconditioned A freight car component which has been remanufactured in accordance with applicable AAR standards or specifications.

Reconstructed Source An existing facility in which components are replaced to such an extent that the fixed capital cost of the new components exceed 50 percent of the capital cost that would be required to construct a comparable entirely new facility. New source performance standards may be applied to sources which are reconstructed after the proposal of the standard if it is technologically and economically feasible to meet the standard.

Record of Decision (ROD) A public document that explains which cleanup alternative(s) will be used at National Priorities List sites where Trust Funds pay for the cleanup.

Rectifier An electrical device which permits flow of electrical current primarily in one direction only. Hence, a device which converts alternating current into direct current.

Red Lead An oxide made from metallic lead and used as a preservative coating on steel. It is frequently painted on the surfaces where two pieces of metal are jointed as in riveting.

Reducing Valve A valve for air or steam that receives the fluid or air at a certain pressure and delivers it at a predetermined lower pressure.

Reduction (Air Brake) A decrease in brake pipe pressure at a rate and of an amount sufficient to cause a train brake application to be initiated or increased.

Reduction Limiting Reservoir Used on locomotive equipment in connection with first service to limit the amount of the initial brake pipe reduction.

Reefer A common slang term for a "refrigerator car."

Refrigerator Car A closed car built with insulation in the floor, sides, ends, roof, and doors, and some form of refrigeration equipment designed for handling commodities requiring cooling during transit. Some refrigerator cars are also equipped with heaters for protection of perishable commodities during sub-freezing weather.

Regenerative Braking The retardation system on electric cars or locomotives which can return power developed by traction motors acting as generators to the third rail or catenary for use by other units.

Regenerative Interlock Valve Used with electric locomotive brake equipment to prevent the operation of the air brake and regenerative brake at the same time to prevent wheels sliding.

Regulated Commodity Used as a synonym for "hazardous material". See Hazardous Material.

Reinforced Flange Fitting A fitting for connecting pipe by use of flanges with devices, etc., held in a manner to prevent pipe breakage from vibration. Later known as Wabcotite fittings and still later as Wabcoseal fittings.

Reinforcement A supplementary part of a structure that strengthens the main carrying members.

Relay A device that is operative by a variation in the conditions of one electric circuit to affect the operation of other devices in the same or another electric circuit.

Relayair Valve™ A registered trade mark name of a device that operates from a controlling device upon a small volume of air for delivering or exhausting a large volume of air. It differs from a relay valve in that it does not respond to increments of controlling pressure change.

Relayair Valve Unit Two or more Relayair valves on a common bracket.

Relay Cabinet Sheet metal cabinet containing relays and electrical apparatus providing control for speed governor, decelostat, sanding, speed indication, overspeed, etc., in connection with electro-pneumatic brakes.

Release That function of the brake whereby the retarding force is removed.

Release Circuit The electric current flow throughout the length of a train by means of connected wiring for energizing and de-energizing release magnet valves for releasing electro-pneumatic (straight-air) brakes.

Release Control Retainer A control device through which brake cylinder air passes. It has a handle with four positions. One position permits free flow of the air to atmosphere; one causes a slow exhaust and holds a low pressure; another causes a slower exhaust and holds a higher pressure; the fourth causes a slow blowdown of all brake cylinder pressure. Pressure retaining valves can be converted to the release control retainer.

Release Insuring Valve A device used as a part of operating valves whereby when a differential of brake pipe pressure over auxiliary reservoir pressure is sufficient to cause release and the piston has not moved the slide valves, the auxiliary reservoir air will be vented to increase the differential and assure the piston's moving to release.

Release Rod A small rod situated at the side sill for the purpose of operating the air brake release valve.

Release Spring A helical spring situated in the brake cylinder so as to exert an inward force on the piston and thereby assist in moving the piston to the released position as cylinder pressure is exhausted to atmosphere.

Release Spring Guide A part of the nonpressure head, as used in AB brake cylinders, which supports the spring and prevents contact with the hollow rod due to vibration.

Release Stability The function in operating valves that prevents unintended application of the brakes.

Release Valve A valve permitting auxiliary reservoir air pressure to be released when the locomotive is detached or when the apparatus is out of order, so as to release or "bleed" the brakes.

Relief Valve A valve, usually held closed by a spring and which is forced open when pressure in the vessel to which it is attached rises above a predetermined value. Often called a safety valve.

Remote Leading locomotive unit in a multiple-unit remote consist.

Remote Control A term denoting the control of any apparatus from a location apart from the location of the apparatus.

Re-Pad A reinforcing pad. A plate welded directly to a tank whose function is to enhance the tank's ability to resist a load at that point. Examples are the bottom tank re-pad between the draft sill and tank and the nozzle re-pad at the base of a top nozzle.

Repair (1) Reconstruction of a car, or a part or parts of a car to its original design. (2) Physical work performed upon a railcar in order to restore original structure because of damage, decay, injury, deterioration or partial destruction. See also Preventative Maintenance.

Repair Date The date repair(s) are completed.

Repair Shop (Facility)/Repair Track A location properly equipped, primarily and regularly used for repair of freight and passenger cars which must be done in compliance with FRA Railroad Freight Car Safety Standards, Safety Appliance and Power Brake Laws, and AAR Interchange Rules.

Reporting Marks The alphabetical initials that are stencilled on the sides and ends of every freight car to identify the railroad or private car line that owns the car. Reporting marks are assigned by the Association

of American Railroads, and in conjunction with the car number, serve to uniquely identify every car in the interchange fleet.

Reproduction Value The cost to replace equipment determined by applicable cost factors. See Rule 107, AAR Field Manual.

Rerailer A portable device designed so that when placed next to the rail, a derailer car or locomotive wheel, when rolled over it, will be guided back onto the rail.

Rescission A federal budgetary term that refers to the cancellation, in whole or part, of budget authority previously granted by Congress.

Reservoir In a fluid system, a tank or other vessel used to contain a supply of the working fluid to make the system function properly. In a car air brake system, the large two-compartment tank that contains compressed air to operate the brake cylinder when the brakes are applied. See Auxiliary Reservoirs and Emergency Reservoir.

Resistance In general, resistance denotes opposition to movement or flow. In mechanical systems, any force that opposes motion such as friction or action of a spring could be termed as resistance. In electrical circuits, resistance is opposition to the flow of current, and is measured in units called ohms.

Responsibility Code Numerical code used on the Billing Repair Card to designate responsibility for repairs made to a car. See Rule 83, Field Manual Of The AAR Interchange Rules.

Retainer The usual term for the pressure retaining valve on freight cars. This manually operated valve can be set to retain a predetermined pressure in the brake cylinder even after the brakes are released, so that the brakes can remain applied on heavy grades while the brake pipe and auxiliary reservoir pressures are restored after a brake application.

Retainer Release Where the release of the brake is accomplished with pressure retaining valves or release control retainers; operative when handles are turned up and inoperative when handles are turned down.

Retardation Change from higher to lower speeds by means of brakes.

Retardation Controller A pendulum type of controller wherein the weight of the pendulum will move freely except as restrained by a spring. When the maximum rate of retardation is reached the spring will be compressed and an electric contact will be made. A magnet valve is operated to reduce brake cylinder pressure and reduce the rate of retardation.

Retardation Factor The relation of train weight to the average retarding force. A retarding force equal to weight of train would be a factor of 1.

Retarded Charge A function in operating valves to restrict the flow of air from the brake pipe to the reservoir to make overcharge less likely and to provide more air flow back into brake pipe for a more uniform releasing and recharging of brakes. Also called uniform recharge and restricted charging.

Retarded Force The force exerted through the friction of the wheel on the rail, or the rail pull.

Retarded Release A feature of K type freight car triple valves employed to cause a slower release of the brake cylinder air on about 25 to 30 cars nearest the locomotive while those on the rear of train are released normally. Since the time for the air to reach the rear cars (up to about 60 to 75) plus the time for release would be about equal to the slower release on the front cars, the total release would be uniform.

Retarder Device used to slow cars in a switching yard while making up a train.

Retention Toilet A toilet system which retains all fluids originating from the use of toilets.

Retest Refers to the requirement to conduct pressure tests on tanks and safety relief valves according to the AAR mandated schedule and procedure.

Return Bend The 180 degree "U"-shaped heater coil (pipe) section that connects adjacent runs of a serpentine heater system.

Revenue Service The ability of a railcar to be used in its present condition for freight transportation.

Reverse Commuting Movement in a direction opposite the main flow of traffic, such as from the central city to a suburb during the morning peak period.

Reverser The handle on a locomotive control stand that selects the direction in which the locomotive will move by reversing the traction motor field connections.

Reversing Valve Used in steam-driven air compressors to cause main steam valve to move by admitting live steam or exhausting it from the outer face of the large main steam valve piston. The reversing valve is actuated through a reversing rod by the steam piston as it completes each stroke.

Rheostat A device used to vary the resistance in an electric circuit as a means of controlling the current flowing in the circuit.

Rider Track A track in a hump yard on which some type of wheeled car is operated for returning car riders to the summit of the hump.

Ridership The number of rides taken by people using a public transportation system in a given time period.

Ridesharing A form of transportation, other than public transit, in which more than one person shares the use of the vehicle, such as a van or car, to make a trip. Also known as "carpooling" or "vanpooling."

Ridge Cap A flanged metal strip to cover the ridge joint on a metal car roof.

Rigid Wheel Base The horizontal distance between the centers of the first and last axles of a locomotive truck.

Right Side (R) When facing the "B" end of a railcar, the side of the car on the right.

Rim On a railway car wheel, that portion around the outer circumference that forms the edge of the tread. The thickness of the rim is a measure of the amount of wear remaining in the wheel, and when this dimension reaches a given limit (as measured with the AAR steel wheel gage), the wheel must be scrapped.

Rim Quench Following heat treatments, all rims are quenched to harden wheel treads.

Ring A rolled tank section attached to a tank head or another tank section.

Ring Grooves (Internal Combustion Engine) Grooves cut in the piston barrel to hold the piston rings.

Rip Track A small car repair facility, often simply a single track in a classification yard or terminal. In larger yards, the rip track may be quite extensive with several tracks and shop buildings. Larger car repair facilities are generally known as "car shops." The name "rip track" is derived from the initials RIP which stands for "repair, inspect and paint."

Riser In car construction, the transverse load bearing members applied to the deck of a flatcar, the purpose of which is to support the lading a specified distance above the car floor to facilitate loading and unloading operations using mechanized equipment. A riser is also the vertical panel between the treads in a stairway.

Riser Boards Wood or steel longitudinal members applied to the deck of a TOFC car adjacent to and on either side of the trailer hitch, the purpose of which is to provide the necessary clearance between the hitch and the undercarriage of the vehicles passing over it.

Rivet A short cylindrical steel rod with a semi-spherical upset head used to fasten parts of a steel structure together. Rivets generally have one head formed prior to positioning, and the other is formed after the joint is assembled, either with hydraulic pressure in a ram (cold riveting), or with air operated riveting guns and a bucking tool (hot riveting).

Roadway Element That portion of the roadway apparatus of automatic train stop, train control, or cab signal system, such as electric circuit, inductor, or trip arm to which the locomotive apparatus of such system is directly responsive.

Rock-and-Roll A slang term for the excessive lateral rocking of cars, usually at low speeds and associated with jointed rail. The speed range through which this cyclic phenomenon occurs is determined by such factors as the wheel base, height of the center of gravity of each individual car, and the spring dampening associated with each vehicle's suspension system.

Rocker Arm A lever, usually mounted on a shaft on the cylinder head, which has one end resting on the valve stem top and the outer end

resting on a push rod whose motion lifts the rocker arm which in turn pushes the valve open.

Rollability A term generally applied in classification yards pertaining to the characteristics of individual cars and their ability to roll.

Roller Bearing The general term applied to any group of journal bearings that employ hardened steel rollers to reduce rotational friction. Roller bearings are sealed assemblies that are mechanically pressed onto an axle, and transfer the wheel loads to the truck side frames through a device known as a roller bearing adapter that fits between the bearing outer ring and the side frame pedestal.

Roller Bearing Adapter A casting that fits between a freight car roller bearing and the truck side frame to transfer the load from the side frame to the bearing.

Roller Bearing Key A retainer for securing a roller bearing assembly in its proper position in the side frame.

Roller Side Bearing A side bearing fitted with rollers to reduce the friction in curving. See Side Bearing.

Rolling Equipment Includes locomotives, railroad cars, and one or more locomotives coupled to one or more cars.

Rolling Stock (1) Any on-track wheeled equipment. (2) A general term used when referring collectively to a large group of railway cars. The vehicles used in a transit system, including buses and rail cars. Includes locomotives, railroad cars, and one or more locomotives coupled to one or more cars.

Roof Hand Hold A bar bent to a required shape and fastened to the roof to be grasped when ascending the ladder at the end of the car. Also called "roof grab iron."

Roof Ridge On a pitched roof, the intersection of the two plain surfaces along the peak, generally at the longitudinal center line of the car.

Roof Sheet The relatively thin steel sheet that is used in fabricating roof sections for freight cars. Roof sheets are often galvanized for protection against rust.

Rope Stop A protection system that runs the length of the conveyor system. When pulled, it shuts down the conveyor belt.

Rotair Valve A registered trade mark name for a rotary type valve controlling the flow of air to and from various parts, devices, supply, etc.

Rotary Coupler A type of freight car coupler used generally on high side gondola cars for coal service with a design feature in the shank that allows the coupler to rotate axially with respect to the draft sill. This feature enables cars to remain coupled while passing through rotary car dumpers, and thus enhances unit train operation by eliminating the need to break up trains for unloading.

Rotary Dump Car A high side gondola or hopper car equipped with a rotary coupler on one end to enable unloading by means of a rotary car dumper.

Rotary Operated Coupler A freight car coupler that is equipped with a bottom operated lock lift mechanism as opposed to the top operated type. The mechanism, located under the coupler head, is termed the rotary operating mechanism because it rotates through an arc when actuated by movement of the uncoupling rod. Not to be confused with rotary coupler.

Rotobrake Retarder™ A registered trade mark name used for apparatus to provide off-the-wheel tread braking.

Rotor The rotating members of motors, generators or motor type relays.

Rounds (Ladder) The horizontal bars on which the foot rests. They are called "rounds" whether made of wood or metal, or whether round or square.

Route Card Board A small wooden board secured to the sides and/or ends of a freight car to enable routing instructions, special loading information, or other cards or papers to be attached to the car with tacks or staples.

Route Miles The total numbers of miles included in a fixed route transit system network.

RPM The common abbreviation for "revolutions per minute," used when referring to the rotational speed of a wheel or shaft.

Rubber Spider The all rubber siphon pipe guide used in rubber lined tank cars.

Rules The AAR Code of Interchange Rules.

Rump Rail In stock car construction, an extra heavy side slat placed about four feet above the floor and running horizontally the length of the car to absorb the major impact of cattle bumping against the car sides.

Run of Pipe A run of pipe or beater coil is defined as one length of pipe running from one end of the car to the other end of the car.

Run-Through Train A train consisting of a solid block of cars handled through a junction point, under an operating agreement, without a scheduled stop other than for necessary change in crew.

Running Board A surface or walkway on cars and locomotives to permit access to hatches, manways or doors, or to facilitate moving on or over the equipment.

Running Gear A general term used to describe the group of parts whose functions are related to movement of the car. Running gear includes the wheels, axles bearings, suspension system and other components of the trucks.

Running Piston Travel The distance the brake cylinder piston moves when the car is in motion with the brakes applied. May be one or two inches longer than standing travel.

Running Repairs A term describing minor, itemized standard repairs performed and billed by the railroads in accordance with the Interchange Rules.

Rupture Disc See Frangible Disc.

S

Saddle A general term sometimes applied to a bracket or other support used on freight cars, so named because it is made to rest on a curved surface in a way similar to a horse saddle.

Saddleback Car A specially equipped flatcar provided with folding pedestals at each end of the car, moveable winches, and bridge plates, used to the transportation of highway truck chassis.

Safety Appliance Any one of several specific components required on railway cars, the functions of which are directly related to the safety of train crew members and other persons whose duties require being on or around the equipment. The design, location, and proper maintenance of safety appliances are strictly regulated by the Department of Transportation. Safety appliances on cars include hand brakes, handholds, ladders, uncoupling levers, sill steps and safety railings.

Safety Breather Vent A device having an operating part which is a permeable disc or is a disc having a breather hole or slit.

Safety Chain A detachable chain sometimes mounted across the access opening on tank car top operating platforms.

Safety Control (Dead-Man) An automatic operation causing train brakes to be applied the moment a foot pedal held depressed by the engineer is released. The safety control operation may be prevented if the locomotive brake is sufficiently applied, or in some cases by depressing the brake valve handle.

Safety Relief Device A device which is designed to prevent the rise of internal pressure in excess of a specified value due to exposure to abnormal conditions. Safety relief device is synonymous with "pressure relief device" as used in DOT regulations.

Safety Relief Valve A device used to protect against an accumulation of excess pressure in a tank car. Usually held closed by a spring, and which is forced open when pressure in the tank rises above a predetermined level.

Safety Tread Material or coverings for step treads which prevent the foot from slipping.

Safety Valve A type of pressure relief valve used to protect against an accumulation of excess pressure in a closed vessel.

Safety Vent An opening formed by a hollow casting or a piece of pipe inserted in the dome of a tank car, used on cars carrying products which are nonflammable or do not give off flammable vapors.

Safety Watch An individual used, to ensure safety, when another person enters a confined space.

Salvage Value The residual value of equipment after it has passed its economic useful life. See Rule 107, AAR Field Manual.

Salvage Value + 20% A calculated value obtained by multiplying the salvage by 120%. See Rule 107, AAR Field Manual.

Sampling Line A device permitting the sampling of the product in a loaded tank car. This line is also known as a "test tube."

Sand Blast A process involving the blowing of a pressurized mixture of sand and air onto a surface for the purpose of cleaning rust, old paint or other contaminants from the surface prior to painting. The cleaning medium can also be steel shot or grit, in which case the process is called "shot blasting" or "grit blasting."

Sandbox A receptacle placed on a locomotive or motor car for carrying sand to prevent slipping of the driving wheels.

Sander A pneumatic or electric device which applies sand to the rails in front of the driving wheels in order to improve adhesion.

Sander Valve A manually operated device for initiating sanding.

Sanding Valve An automatically operated device for causing the flow of sand.

Sandpipe The tubes leading down from the sand box outlets to the rails in front of the driving wheels.

Sandwich Car A super insulated tank car whose inner tank is supported solely by urethane foam insulation, thereby eliminating most of the metal heat loss paths from the inner tank to the atmosphere. Class AAR 206A or DOT 115A.

Satellite Shop (Pool Operation) See Designated Satellite Shop.

SAV Nozzle Siphon and air vent nozzle. The top nozzle on non-pressure tank cars upon which the top unload valves and other fittings are normally mounted.

SAW See Submerged Arc Welding.

Scale Test Car A car equipped with mechanical appliances for testing the balance of track scales as to their correctness according to the Government Bureau of Standards. See Test Weight Car.

Scarf The joint where piston rings lap.

Scavenging (Internal Combustion Engines) The sweeping out of an engine cylinder by piston movement or a blast of air of all or most of the gaseous products of the preceding fuel combustion.

Schnabel Car A specially designed car used for transportation of extremely large and heavy machinery. The car is constructed with two separate units, each capable of standing alone on its own trucks. The load is placed between the tow carrying units, and rigidly fastened to them, thus becoming literally part of the carbody.

Score A narrow deformation, caused by mechanical means, wherein parent or weld metal is upset and relocated.

Scoring Groove A groove machined around a tank car outlet valve casing, making a weak point at which failure will occur without damage to the valve seat if the valve becomes overstressed. Also called "breaking groove."

Screwed Refers to valves or other fittings whose end connections consist of pipe threads.

Scrubber An air pollution device that uses a spray of water or reactant or a dry process to trap pollutants in emissions.

Seal A general term used to describe any device used to close off completely, to prevent leakage, or to secure. Typical examples of seals found in railroad car work are: air brake valve gaskets, rubber washers in air hose connections, packing in valves and car door seals. See Car Seal.

Seat In mechanical systems, a term used to describe a specific location or surface on which another part rests and often depends for proper operation, such as a valve seat.

Seat (Safety Relief Valve) That part of a safety relief valve in it's orifice area that forms a seal with the stem and adjacent parts.

Secondhand A used component of a freight car meeting current AAR Interchange requirements.

Section Relates to the part of the Federal Transit Act (formerly known as the Urban Mass Transportation Act of 1964), as amended, that authorizes discretionary funds for capital public transportation projects.

Section 9 The section of the Federal Transit Act (formerly known as the Urban Mass Transportation Act of 1964), as amended, that authorizes grants to public transportation systems in urbanized areas (population greater than 50,00) for both capital and operating programs based on formulas set out in statute.

Section 13(c) The section of the Federal Transit Act (formerly known as the Urban Mass Transportation Act of 1964), as amended, related to labor protection that is designed to protect transit employees against a worsening of their position with respect to their employment as a result of grant assistance under the Act.

Section 15 The section of the Federal Transit Act (formerly known as the Urban Mass Transportation Act of 1964), as amended, that authorizes the US Department of Transportation to gather statistical information about the financing and operations of public transportation systems, based upon a uniform system of accounts and records.

Section 16 The section of the Federal Transit Act (formerly known as the Urban Mass Transportation Act of 1964), as amended, that authorizes grants to nonprofit corporations and associations for the specific purpose of assisting them in providing transportation services meeting the special needs of elderly persons and persons with disabilities for whom mass transportation services are unavailable, insufficient or inappropriate.

Section 18 The section of the Federal Transit Act (formerly known as the Urban Mass Transportation Act of 1964), as amended, that authorizes grants to public transit systems outside urbanized areas, based on formulas set out in statute; the funds go initially to the governor of each state.

Selector Gage Used to determine the size of ring for a piston cylinder; also called a cylinder gage.

Selector Valve A name given to several devices which are used to automatically change the functioning of valves or equipment. Used with AB-1-B freight brake equipment to change emergency function for freight or passenger. Also name for device used with D-24 brake valves to provide means of charging brake pipe supply with air feed valve pressure or main reservoir pressure.

Self-Contained A car fitted with some form of generating unit or other devices to enable the car to operate without being supported by a train or yard electrical or other systems.

Self-Cleaning A term applied to cars designed to discharge their lading by gravity through bottom or side dumping mechanisms without any external assistance.

Self-Lapping Valve A mechanism that operates to supply and maintain air pressure in accordance with a positioning arrangement either manual or automatic. Used in brake valves, relay valves, etc.

Semi-Envelope Air Distribution Air distribution for refrigerator cars in which the cooled or heated air is passed through ducts and flues in ceiling, sides and ends with air return beneath the floor racks on which the lading is placed.

Semiconductors Material, such as germanium and silicon, the conductivity of which can be controlled to make devices such as diodes which function as rectifiers.

Sequestration A federal budgetary term that refers to the permanent cancellation of budget authority.

Serial The function of an operating valve which assists associated valves in operating. Quick action is passed from one operating valve to another to provide serial quick action. Quick service or accelerated release are serial actions.

Series A method of connecting electric apparatus so that the negative side of one unit is connected to the positive of the next and the full current passes successively through each piece of apparatus in the circuit. See Parallel (Electric Circuit).

Series Circuit A circuit in which the separate sources or separate electro-receptive devices or both are so placed that the current produced in it or going through it passed successively through the entire circuit.

Serpentine Systems A tank car heater system with only one possible passage or route from inlet to outlet. Can be used with either steam or liquid heating medium.

Service Application A term used to denote a full or normal application of the air brakes on a car or train. A service application is initiated by reducing brake pipe pressure at a rate sufficient to cause the control valve on each car to assume its "service" position and function to cause auxiliary reservoir air to enter the brake cylinder.

Service Metal (Wheels) Usable metal remaining on a wheel above the above the pricing condemning limits. See AAR Office Manual, Rule 41.

Service Portion One of three parts of an air brake control valve.

Service Stability The ability of an operating valve to ensure that emergency operation will not occur when service operation is intended.

Set The distance coil spring deflects under load. In an eliptic spring, the set is defined as the distance between the spring bands at the center of the arch. Permanent set is the decrease in free height of any spring that normally occurs over a period of time due to repeated cycles of loading to full travel.

Set-Off A term descriptive of a car or cars detached from a train en route between yards or terminals.

Set Pressure The pressure, measured at the valve inlet, at which a safety relief valve is set for start-to-discharge.

Settlement Value (DV [Dollar Value]) An AAR term denoting a preset dollar amount to be paid after a railcar has been damaged by a foreign railroad and the owner decides to remove the car from permanent service.

Shaft In construction work, a pit or well sunk from the ground surface above into a tunnel for the purpose of furnishing ventilation or for facilitating the work by increasing the number of points from which it may be carried on. In machinery, a round bar, often iron or steel, usually associated with rotation.

Shaker A pneumatic or mechanical device which, when attached to shaker plates installed on hopper cars, will vibrate the lading sufficiently to induce unloading.

Shank (of a Coupler) That portion of a coupler between the head and rear surface of the butt.

Shearing Stress Any force causing two contacting parts or layers to slide upon each other, moving apart in opposite directions parallel to the plane of their contact.

Sheathing The outside covering of car sides and ends.

Sheave A wheel, roller or pulley, over which a rope, belt, or chain runs.

Sheave Pin or Pintel The axle of a sheave.

Sheave Wheel A grooved wheel over which a chain, cord or cable runs.

Sheet The plates used in enclosing all types of steel cars are termed sheets as end sheet, side sheet, roof sheet, floor sheets, etc.

Shelf Coupler A special coupler, required on some cars designed for transporting hazardous commodities, having top and bottom "shelves" cast integral with the head to prevent vertical disengagement of mating couplers in the event of an excessive end impact. Shelf couplers are fully compatible with other standard AAR couplers. See Head Shield.

Shelf Life Maximum interval in which a material may be stored and still be in useable condition.

Shell Capacity The capacity of a tank car as measured by the amount of product a tank car contains when the tank shell is completely full.

Shell Full Capacity The maximum volume of a tank, not including any required outage.

Shelling A wheel defect characterized by pieces of metal flaking out of the tread surface, and caused by fatigue failure of the metal in the tread.

Shell Innage A term which designates the depth of the product contained in a tank car.

Shell Outage The unfilled portion of a tank car tank as measured by the vertical distance from the underside of the tank shell at the top to the level of product in the tank.

Shielded Metal Arc Welding An arc welding process utilizing coated metal electrodes. The heat of welding vaporizes the coating thereby forming a protective atmosphere around the molten metal.

Shifter Lever Located on a brake valve for the purpose of changing from electro-pneumatic (straight-air) control to automatic control or the reverse of the train brakes.

Shim A thin piece of wood or steel used to properly position one part with respect to another, or to position a complete unit correctly with respect to its supporting or surrounding structure.

Shipping Cover Used to protect valves or valve portions in shipping transit or from the cleaning room to the yard tracks where valves are changed.

Shock The effect of a sudden change in speed of a car, locomotive or train, or part of a train.

Shoe In general, any block, plate, or other configuration of material, the function of which involves sliding or rubbing on some other surface. See Brake Shoe and Pantograph.

Shopping The removal of a car from service for repair, service or inspection.

Shop Turnaround Time Begins when the delivering railroad sets a car in at the shop and ends when the car is offered to the railroad on the outbound track.

Short Circuit Gas Metal Arc Welding (GMAW-S) A gas metal arc welding variation in which the consumable electrode is deposited during repeated short circuits.

Short Circuiting Arc Welding A nonstandard term for short circuit gas metal arc welding.

Short-Cycle Method of Braking Used on heavy descending grades where retainers must be used (turned up). Consists of making frequent applications and short holds. The cycle includes the reduction release and recharge which will vary from 45 seconds on a short train (75 or less cars) to 2½ to 3 minutes on a long (150-car train).

Shot A blasting material consisting of spherically shaped particles of steel or iron.

Shutters In engine cooling systems, an assembly of movable vanes, mechanically connected to operate in unison that are actuated by a pneumatic magnet valve controlled by an engine temperature switch.

Shuttle (1) A public or private vehicle that travels back and forth over a particular route, especially a short route or one that provides connections between transportation systems employment center, etc. (2) The movable conveyor belt located on the shiploader.

SI Units SI is the official abbreviation, in all languages, for the International System of Units. The International System is not the old centimeter-gram-second system, but a modernized version of it. It is a coherent system in which there is a one-to-one correspondence among all the base units and derived units. The SI style for writing large numbers calls for eliminating commas and writing numerals in groups of three on either side of the decimal point.

Side Bearing A load bearing component, located either on the truck or body bolster, and arranged to absorb vertical loads arising from the rocking motion of the car. There are various types of side bearings ranging from simple flat pads to complex devices which maintain constant contact between the truck bolster and carbody. See Body Side Bearing and Truck Side Bearing.

Side Bearing Brace A filler block between the body bolster diaphragms that supports the side bearing.

Side Bearing Clearance The space between mating body and truck side bearings on cars with conventional side bearing arrangements. The Association of American Railroads has established minimums and maximums for this dimension, when measured on level tangent track.

Side Bearing Roller A solid steel cylindrical roller which fits loosely in a rectangular retainer or "cage," fastened to the truck bolster, and contacts the body side bearings during lateral rocking of the car. The rollers are used either singly or in pairs, and have the advantage of decreasing resistance to truck rotation when the car is rounding a curve.

Side Bearing Truck A truck in which the weight of the car is transmitted at the side instead of the center.

Side Door Any door arrangement in a car side, as distinguished from end doors, drop doors or hopper doors.

Side Door Bottom Guide A bracket attached to the side of freight cars having sliding doors to guide the door while it is being opened and shut and also to prevent its swinging away from the car at the bottom.

Side Dump Car A car so constructed that its contents may be discharged to either side of the track through doors in the car sides or drop doors in the floor.

Side Frame In the conventional three-piece truck, the heavy cast steel side member which is designed to transmit vertical loads from the wheels through either journal boxes or pedestals to the truck bolster.

Side Frame Key A short steel retainer bolted to the bottom of a pedestal type side frame to prevent roller bearing assemblies from becoming dislodged from the side frame pedestals. Sometimes called a roller bearing key.

Side Ladder One of two ladders, generally located near the center of each side of a tank car, for the purpose of providing access from the ground to the top operating platform.

Side Loading A method of loading or unloading containers or highway trailers on or off flat cars by physically lifting the unit over the side of the car with heavy duty mobile loading equipment. See Circus Loading.

Side Plate A structural member of a boxcar side assembly extending the length of the car at the top of the sides, and to which the roof carlines are attached.

Side Posts Any one of a series of vertical structural stiffening members located along the length of a covered hopper car side sheet, and attached thereto.

Side Safety Rail A railing running the length of each side of a tank car at ground level.

Side Sheet The steel panels fastened to side posts that close in the sides of the car.

Side Sill The outside longitudinal members of the underframe. In some designs of cars, the side sills are dispensed with and the entire side of the car is designed as a deep plate girder to carry most of the load to the bolster.

Side Slope That part of the floor which slopes from the side of a hopper to the hopper floor.

Side Stakes Heavy vertical steel posts that provide the main structural support for hopper or gondola car sides.

Side Strut For Hopper Floor An inclined strut or support for the hopper floor between the bolster and the end of the car, fastened to the corner of the end sill.

Signal, Automatic Block Signal System A block signal system wherein the use of each block is governed by an automatic block signal, cab signal, or both.

Signal Hose An air hose similar to, but of smaller diameter than, an air brake hose, and used between cars to connect the train air signal lines.

Signal Pipe The pipe with hose connections and proper fittings for conveying compressed air throughout a passenger train for use with the air signal equipment. Previously and still often called "signal line."

Signal Valve A valve that responds to signal pipe pulsation (reductions) and controls sounds of the air signal's whistle.

Signatory/Subscriber A car owner or railroad that is part to the interchange agreement.

Significant Digits A significant digit is any digit that is necessary to define the specific value or quantity. When measured to the nearest 1 m, a distance may be recorded a 157 m; this number has three significant digits. If the measurement had been made to the nearest 0.1 m, the distance may have been 157.4 m; this number has four significant digits.

Sill The general term used to describe main structural members of a car underframe. See Center Sill, Side Sill, End Sill.

Sill (Construction) The lowest horizontal member of a framed bent.

Sill Pad The steel step located at each bottom corner of a railcar.

Sill Step A steel step fastened to the side sill at each corner of a car to provide footing for employees whose duties require that they be on the equipment. Sill steps are considered safety appliances and are subject to very strict regulation as to their dimensions and location on a car.

Single-Car Testing Device A portable testing device used for check testing the brake equipment on a car.

Single Type Brake Where one brake shoe is used on a wheel, contrasted with clasp type brake where two brake shoes are used, one on each side of the wheel.

Single-Welded Butt Joint A butt weld with filler metal added from one side only. This joint is considered equivalent to a double-welded butt joint if means are provided for accomplishing complete penetration and weld reinforcement on both sides of the joint.

Siphon Pipe See Education Pipe.

Siphon Pipe Guide See Education Pipe Guide.

Size (Fillet) For an equal leg fillet weld, size is the leg length. For an unequal leg fillet weld, both legs must be dimensioned.

SJV Swedish State Railway.

Skate A metal skid or chock (wedge) placed on rail to stop the movement of rolling stock.

Skid The cast or fabricated structure mounted to the bottom exterior of a tank to provide shear-off protection for bottom discontinuities such as, bottom valves, sumps, or washouts.

Slack Unrestrained free movement between the cars in a train.

Slack Action Movement of part of a coupled train at a different speed than another part of the same train.

Slack Adjuster A device installed in the foundation brake rigging of a railway car, usually near the brake cylinder live lever, used to automatically compensate for variations in the brake rigging caused by brake shoe and wheel wear or replacement. The slack adjuster functions to take up rigging slack as wear occurs, or to let out slack when new shoes or wheels are applied. Brake cylinder piston travel is thereby automatically maintained at its optimum length without the need for manual brake rigging adjustments.

Slid Flat Wheels Railcar wheels with flat spots resulting from sliding on the rail; generally, due to over braking or failure to release the car handbrake. Flat spots larger than the AAR maximum allowed are a cause for wheel replacement.

Slide Wheel sliding is where the wheel does not rotate on its axle and motion exists between the wheel and the rail.

Slide Valve A sliding piece of material such as brass, iron, plastic, etc., fitted airtight on a seat that is moved by some means such as piston, diaphragm, etc., for the purpose of connecting or closing under certain conditions.

Sliding Chair A casting attached to a brake beam which slides on an inclined member in such a way as to secure a proper adjustment of the brake shoe as it wears.

Sliding Door A door which opens by moving sideways instead of swinging on hinges.

Sliding Sill A term used to describe a type of hydraulic cushioning for freight car underframes. In sliding sill designs, a single hydraulic unit is installed at the center of the car and acts to control longitudinal forces received at either end of an auxiliary center sill, which is free to travel longitudinally within a fixed center sill.

Slip Wheel slipping is where the wheel rotates on its axle, also with motion existing between the wheel and rail at the area of contact.

Slope Sheet In hopper car construction, the steel sheets that slope from the sides and ends to form the hoppers in the bottom of the car.

Slot Weld A weld made in an elongated slot through one member of a lap joint.

Slug A cabless locomotive which has traction motors, but no means of supplying power to them by itself. Power is provided by power cables from an adjacent unit. Slugs are used where low speeds and high tractive effort are needed, such as in hump yards.

Slump Reservoir A reservoir used in connection with main reservoirs to collect oil and moisture to prevent them from reaching the air brake devices.

SMAW Acronym for Shielded Metal Arc Welding.

Smoke Jack A term commonly applied to the outside portion of a smoke flue when used on caboose and work cars.

Snubbers Hydraulic or friction damping devices used in suspension systems of cars to improve lateral stability. Some snubbers are designed to replace one spring in the truck spring group, some are incorporated as part of the truck side frame or bolster design, and others require special installation. Supplemental hydraulic snubbing is used most often on cars with high centers of gravity such as 100-ton coal hoppers or gondolas, and tri-level automobile rack cars.

Solenoid A coil of insulated copper wire wound on a spool which, when an electric current flows through the wire may draw or attract an iron rod, core or plunger into its interior. A modified form of electromagnet. Used as a means for operating regulators, switches and other electrical apparatus.

Solid Bottom Car Usually an open top gondola car without openings in the floor or bottom for discharging the load.

Solid-State Inverter A sophisticated, computer-driven device used to generate, modify, or alter electrical waveforms and frequencies, is an essential component used to control and regulate alternating-current (AC) induction traction motors of modern locomotives.

Sonic Testing Means by which thickness of a tank car is measured. Also used for flaw detection.

Span Bolster A beam-like structure with each end resting on a conventional truck bolster and arranged to support a carbody through a center plate at or near its midpoint. Span bolsters can also be used with two six-wheel trucks to provide 24-wheel (12-axle) support under extremely heavy cars.

Spanner A wrench for uncoupling hose, etc., formed like the arc of a circle, with notches or lugs, for engaging grooves on a spanner nut.

Spark Arrester A cage-like device of rust-resistant perforated sheets, wire, or expanded metal installed in the flue at the top of an exhaust stack or chimney, the purpose of which is to reduce the hazard from flying sparks.

Spark Test An inspection procedure used to detect minute gaps and pin holes in rubber tank car linings.

Specific Gravity A ratio of the weight of a given solid or liquid to the weight of an equal volume of water under specified standard condition. Materials with specific gravities less than 1.0 will float on water and those with specific gravities greater than 1.0 will sink.

Specification Detailed requirements that a design, product, device or facility must meet to be eligible for AAR approved status. These requirements may pertain to performance, methods of fabrication, material, quality control, laboratory and field test procedures, or other criteria. (AAR)

Speed Control A device which will automatically apply the brakes on the train or engine unless the speed conforms to the cab signal indication.

Speed Governor Control A feature for passenger brakes whereby through use of electro-pneumatic devices the braking forces will be in proper proportion to the speed to obtain the shortest practical stop with comfort to passengers and without damage to equipment.

Speed Medium A speed not exceeding 40 miles per hour. Restricted, a speed that will permit stopping within one-half the range of vision, but not exceeding 20 miles per hour. Slow: A speed not exceeding 20 miles per hour.

Speed Recorder A device, usually driven from an axle of a truck, which indicates and records the speed of a train. Business cars, dynamometer cars and locomotives are equipped with speed recorders.

Speed Set A designed control permitting the driver to set the maximum speed of the locomotive using a dial on the console. The control limits top speed but does not apply or release braking to regulate speed.

Spill-Over A function of operating valves whereby the quick-action chamber of the emergency portion is connected to the emergency reservoir to make less likely the overcharging of the quick-action chamber that would tend to cause undesired emergency operation.

Spiral Elliptic Spring A spring made of a thin band of steel wound in a spiral coil, the transverse section of which is elliptical.

Splice Plate A steel plate usually of some specified dimension, spanning a break or a joint in some structural member, and securely fastened (usually welded) to both parts so as to form a continuous member.

Split Layer Technique Welding technique in which more than one pass is used for each layer of weld metal.

Split Reduction A term describing a method of making an air brake application (brake pipe reduction) in two or more steps to produce smoother stopping.

Split Switch (Slang) A term referring to the condition that exists at a switch when one pair of wheels under a car follows a course different from all other wheels under the car, generally resulting in a derailment. The errant wheels are said to have "picked" the switch.

Spot Weld (Structures) A weld made by fusing parts together under pressure when heated by a localized current; used chiefly in pressed-steel and sheet metal work.

Spotting The act of placing a car in a specific location on a track.

Spreader A piece of maintenance-of-way equipment having plow-type blades for distributing ballast on the roadbed. The term spreader is also used to refer to the connection between the two vertical truck levers in truck brake rigging. See Bottom Rod.

Spring A general term referring to a large group of mechanical devices making use of the elastic properties of materials to cushion loads or control motion. See Coil Spring, Elliptic Spring, Truck Springs, and Volute Spring.

Spring Band A metal strap with embraces the plates or leaves at the center of an elliptic spring.

Spring Cap A cup-shaped piece of cast or wrought iron for holding the top of a spring and against which the latter bears. They are further distinguished by the name of the spring, such as bolster spring cap, etc.

Spring Clip The cap or fastener at the ends of elliptical springs. Also called "spring block."

Spring Controller A telescopic band which guides or keeps coil springs in proper position.

Spring Dampener A device to increase the capacity of a spring by bringing into play a certain amount of friction which helps to absorb the load or shock.

Spring Deflection The difference between the free height and the loaded height of the spring.

Spring Group Any combination of standardized coil springs used in each truck side frame, and selected to match car capacities and obtain desired vertical suspension characteristics. Cars are often stenciled to show the number of specific springs of various designations, e.g., 5 D5 outer 3 D5 inner, that make up the spring group standard to the car.

Spring Leaf The principal component of an elliptic or semi-elliptic spring. They are made of flat spring steel in varying lengths, held together at the center by a band.

Spring Nest Two or more coil springs of different diameters, one fitting inside the other and acting in combination. Truck springs are commonly made up of standardized outer and inner coils, nested and arranged in various spring groups.

Spring Plank A steel plate fitting under each end of the truck bolster on older trucks to provide a bearing surface for the spring group.

Spring Plate A common term for spring seats and caps, especially those of considerable size, as for bolster springs. They are often provided with spring plate lugs to hold the spring in place.

Spring Seat A cup-shaped piece of cast steel, or cast wrought iron, on which the bottom of a spring rest. Also called "spring plate." They are further distinguished by the name of the spring for which they serve such as bolster spring seat, equalizer spring seat. See Spring Cap.

Stack A chimney or smokestack; a vertical pipe that discharges used air.

Stainless Steel An alloy steel containing relatively large amounts of chromium and nickel which greatly enhance the corrosion resistance.

Stainless Steel Trim Refers to a valve with stainless steel internal working parts (e.g., ball, stem, plug, etc.) but, whose body is carbon steel.

Stake Pocket A "U"-shaped collar attached to the side or end sill of a flat car to receive the lower end of a stake used for securing open top loads.

Stamped Marked by means of a steel stamped.

Stanchion See Trailer Hitch.

Stand Pipe See Siphon Pipe.

Standard (AAR) A specification, procedure, practice, definition, design, product or device which is approved by the AAR to serve as the requirement for use in unrestricted interchange service.

Standard Gage The standard distance between rails of North American railroads, being 4' 8½" measured between the inside faces of the rail heads.

Standard Level A term referring to the deck height of many intermodal and automobile rack flatcars, to differentiate them from so-called low level cars. Standard level cars have a deck height of 41½" as opposed to the 31½" deck height of low level cars.

Standard-Level Car A flat car with the deck or floor at the "standard" height of 41 to 42 inches. Such cars have a straight center sill (the longitudinal structural member at the center of the underframe) and trucks using conventional wheel sizes (33 inches for 70-ton cars).

Standard Point Location Code (SPLC) Six-digit number indicating the geographics station where repair(s) are performed for a given shop.

Stand-By Ladle Positions A pouring tank with a filled ladle of molten steel is held here to be moved into position at the pouring station after the last wheel has been poured from the unit already at the station.

Standing Piston Travel The distance the brake cylinder piston travels with the brake applied when the car is not in motion.

Star Symbol A term sometimes used to describe the star stenciled immediately to the left of capacity and/or load limit markings on freight cars to indicate that the starred figures have been reduced below those normally expected for the size of journal bearings and axles under the car. Starred capacity and load limit figures must not be changed without authority from the car owner.

Start-To-Discharge Pressure The pressure, measured at the valve inlet, at which there is a measurable lift of the closure device on a safety relief valve, or at which discharge becomes continuous.

Start-To-Leak Pressure The pressure measured at a safety valve inlet, at which fluid is first detected at the valve outlet.

State Implementation Plan (SIP) A state plan mandated by the Clean Air Act Amendments of 1990 (CAAA) that contains procedures to monitor, control, maintain and enforce compliance with national standards for air quality.

Static Friction Friction at rest such as that between the wheel and rail.

Steam Generator For heating passenger cars and operating steam ejector type of air conditioning, a boiler is applied to passenger diesel locomotive. They are generally equipped with an automatic oil fired burner and function without any attention except to start and stop them.

Steam Jacket An enclosure around a pipe, tank or nozzle to enable steam to be injected and circulated around the equipment to facilitate flow of the product within the system.

Steam Throttle Valve Located in steam supply pipe to compressors, operated by air from the main reservoir to prevent full-flow of steam until enough air pressure is obtained to provide a cushion for the pistons of the compressor. Also, it is the operating valve the engineer uses to control the steam locomotive.

Steam Trap A device for catching and liberating the water of condensation in any steam pipe line.

Steeple Cab Electric locomotive with cab in center and sloping hoods at each end.

Stencil Marked by means of paint or decal.

Stenciling A term used to describe all forms of lettering on cars regardless of the actual method of application.

Step A general term to describe any one of many arrangements providing a place to stand or to place one's foot. See Brake Step, Sill Step.

Step Riser The vertical portion of a step in stairs.

Stick Welding See Shielded Metal ARC Welding.

Stile The upright pieces on the outer edge of a door, sash, or ladder.

Stirrup A bent bar of steel resembling somewhat the stirrup of a saddle and used to support another piece.

Stock Car A rail car designed for the transportation of livestock and equipped with slatted sides and doors.

Straight-Air Application Any application of a straight air brake. The electro-pneumatic control of the brake as distinguished from the automatic or pneumatic control.

Straight-Air Brake An obsolete type of air brake equipment once used on freight cars but now only seen in very specialized circumstances. It was used extensively as the independent brake on a locomotive. Air is admitted directly to the brake cylinders using a brake valve separate from or independent of the automatic brake valve. See Automatic Air Brake.

Straight-Air Brake Valve A device by means of which air is admitted to and exhausted from the brake cylinder directly from the source of supply such as main reservoir; or reducing valve with no relay type of device such as distributing valve.

Straight Shell A term used to describe a straight tank, i.e., one without a sloping top or bottom.

Strainer A cleaning device installed within devices and in piping to prevent foreign matter reaching operating parts. Strainers have included cleaning devices where the primary cleaning element is not felt, but often fine wire mesh.

Strap Bolt A round bolt with a flat bar or iron or steel welded to it, and usually with a hook on the end which serves as a head. The flat bar has holes in it, by which it can be fastened in place with rivets, bolts, or screws. Also called "lug bolt."

Strap Washer An iron or steel strap which takes the heads of several bolts. Also called "washer plate."

Street Car See Rail, Light.

Stress A term used in engineering to denote force per unit of area in structural members, expressed commonly in units of lbs. per sq. inch, (psi). Stresses are classified by the type of reaction they produce in the fibers of the material they affect. Tensile stress tends to pull apart, compressive stress tends to press together, and sheer stress tends to slide parallel adjacent surfaces against each other in opposite directions.

Stress Relief Commonly used as a synonym for post weld heat treatment.

Stress Relieving Heating to a suitable temperature, holding long enough to reduce residual stresses, and the cooling slowly enough to minimize the development of new residual stresses.

Stretch Braking A method of controlling and limiting drawbar slack forces. A slight brake application is made to prevent cars from freely rolling. Train speed retardation is compensated by applying locomotive power which pulls on the car couplers, keeping coupler forces in tension and the slack between couplers stretched.

Striker The heavy cast, forged, or fabricated bar fastened to the end of the center sill at the top, and designed to be the first point of contact in the event the car coupler is driven back far enough to strike the carbody. Its function is to absorb the resulting impact and prevent damage to the center sill and surrounding area.

Striking Horn The stop shoulder, or horn of a coupler, arranged to touch the striking plate before the draft gear goes solid.

Stringer A longitudinal member of a car underframe usually designed to be a floor support rather than to perform the function of a sill.

Stroke (Internal Combustion Engines) The distance that a piston moves from one end of its path to the other. The piston stroke is equaled to twice the length of the crankarm.

Structure All the parts which comprise a railcar or track, together with the particular manner or way those parts are constructed; the composite of understructure and superstructure. See Railcar, Superstructure, Understructure, Underframe, and Track Structure.

Strut A term applied to any member of a structure normally subjected to compressive stresses.

Strut Cylinder A device, used with the empty and loaded freight car brake equipment, which measures the car truck spring deflection. It positions the changeover valve automatically during the charging of the equipment for the use of one or two brake cylinders, depending on the car load.

Stub Sill A short longitudinal structural member of a car underframe designed to accommodate the coupler and draft gear, and to transmit coupler forces to the carbody on cars designed with no through center sill. Common stub sill applications are found on tank and covered hopper cars.

Stud A headless bolt either welded or otherwise secured to some component, and used for attaching an adjoining component by means of threaded nut.

Stuffing Box An enclosure containing packing to prevent leakage around a machine part.

Submerged Arc Welding An automatic arc welding process capable of depositing relatively large amounts of weld metal in a single pass.

Suburban Rail See Rail, Commuter.

Subway See Rail, Heavy.

Subway Car An electric motor car for use in rapid transit service in large.

Sump A small depression located near the longitudinal center of a tank bottom.

Supercharger An exhaust-gas turbine and a centrifugal blower or compressor mounted on a common rotor shaft which delivers air to an engine at a pressure above atmospheric. Turbine utilizes energy in the exhaust from the engine to operate the compressor.

Superliners Bi-level passenger cars operated by AMTRAK in long-distance service.

Superstructure The assembled parts above the understructure including the sides, ends, roof, gates, doors, slope sheets, flooring above the underframe, lining and all accessories and appurtenances, carbody.

Supplemental Appropriation An act appropriating funds in addition to those in an annual appropriation act because the need for fund is too urgent to be postponed until enactment of the next regular appropriation act.

Supplementary Reservoir Used with passenger car brake equipment for such features as quick recharge, graduated release, and high emergency pressure.

Supply Pipe (Air Compressor) A pipe sometimes connected to the air inlet of an air compressor by means of which the air supply is drawn from a point some distance away from the compressor.

Supply Reservoir Used to supply brake cylinder air on passenger cars where a relay valve functions through an operating valve such as a type D-22 control valve.

Suppression A position on the quadrant of the 26C Automatic Brake Valve in which the handle must be placed to recover from a penalty brake application. This is also a feature used to prevent an automatic train control brake application.

Surface Area Normally refers to the surface area of a tank expressed in square feet.

Surface Crack A separation of material extending 1/16 inch or less through the tank plate thickness.

Surge An uncontrolled flow of air.

Surge Reservoir A volume of air included in the feed valve delivery line to prevent overcasting (the feed valve delivering more pressure before closing than that for which it is adjusted).

Surplus Cars Empty revenue freight cars not in transit; including cars stored for special or future loading, in excess of shippers' orders for cars.

Suspension The resilient system through which a carbody is supported on its wheels. Suspension systems involve the use of hydraulic devices, friction elements and coil, elliptic, rubber or pneumatic springs.

Swab A lubricant-absorbent substance to provide means of continuous lubricating of piston rods, cylinders, etc.

Swing Bolster A truck bolster suspended by hangers or links so that it can swing laterally with relation to the truck and thus lower the effects of lateral impact received through the side frames and wheels. Trucks equipped with swing bolster are known as swing motion trucks.

Swing Hanger Bars or links, attached at their upper ends to the frame of a swing motion truck, and carrying the spring plank at their lower ends. Also called "bolster hanger."

Swing Hanger Pin Bearing A casting that acts as a bearing for a swing hanger pin.

Swing Hanger Pin (Lower and Upper) A steel bar by which a swing hanger on a car truck is suspended, or which supports a spring plank. The lower swing hanger pivot is sometimes called a cross bar or mandrel pin or axle. The upper one is carried in a swing hanger pin bearing attached to the transom.

Swing Link Hanger A swing hanger made in the form of an open link.

Swing Motion Truck A truck with a bolster and spring plank suspended on swing hangers so that they can swing laterally in relation to the truck frame.

Switch and Lock Movement A device, the complete operation of which performs the three functions of unlocking, operating, and locking a switch, movable point frog, or derail.

Switch Proving Access A switch which if transversed by rolling equipment could permit that rolling equipment to couple to the equipment being protected.

Switcher A term used for a switching locomotive.

Switching Switching service consists of moving cars from one track to another track or to different positions on the same track. It includes the moving of cars in the make-up and break-up of trains; also moving of cars on industrial switching tracks or interchange tracks, and the general movement of cars within terminals or at junctions.

Switching Locomotive A locomotive used for shifting or switching cars in yards and terminal. Sometimes termed "switcher."

Swivel Butt Coupler An obsolete coupler design in which the solid shank was replaced by a swiveling butt casting connected to the coupler itself by means of a pin.

Synchronized Brakes Functions so designed that brakes will operate harmoniously.

System Car A car owned by the subscriber.

System Repair A repair performed by owner of the car.

T

Take-Up Cylinder The small cylinder of the 4-12 type which is used to take up the brake gear slack and make possible the use of a large brake cylinder of short piston travel. No more reservoir capacity is required than with usual brake equipment. A higher braking force is available for extra large cars. Also used for the same purpose with "empty-and-load" equipment used on very heavy coal cars.

Tally Card A card or envelope provided to facilitate check of passengers on train by the conductor and crew.

Tamper A power-driven machine for compacting ballast under ties.

Tandem Refers to a geometrical arrangement of electrodes in which a line through the arcs is parallel to the direction of welding.

Tank The completed vessel assembly of a tank car, consisting of 2 heads, a number of ring sections, and one or more nozzles.

Tank Anchor Longitudinal steel sections fastened to the center sill which are in turn fastened to the tank to anchor it to the underframe at the center of the car.

Tank Band An iron strap which passes around the tank of a tank car to hold it in place on the underframe of tank cars using this arrangement.

Tank Bottom Outlet Valve A valve attached to the bottom of the tank to draw off the contents.

Tank Car Built Date The date (month and year) the completed car is shipped from the car builder's facility. Tank cars shipped to lining appli-

cator, whether or not returning to the car builder after lining, are considered "built" as of the first departure from the car builder's facility.

Tank Car Consists of a shell and heads together with connections welded directly thereto. As used in these specifications, "tank" means tank car tank. The head of a tank is one of the end closures. Tank cars may be pressure or non-pressure, and are often equipped with special equipment to enhance their usefulness for handling specific commodities. For pressure class tank cars, the tank includes the manway nozzle as well.

Tank Car, Certified The car is a stub sill, non-pressure, non-exterior coiled car built prior to July 1, 1974 and meeting the requirements of AAR Tank car Specification M-1002.

Tank Car, Light Weight Scale weight of car to the nearest 100 pounds. If scale weight indicates an even 50 pounds, the lower multiple must be used.

Tank Car, Load Limit Maximum permissible weight that can be loaded into car. Calculated by deducting the light weight of car from the total allowable weight on rail for applicable axle size.

Tank Car, Non-pressure "Shell-Full" The volume corresponding to a liquid level at the inside top of the shell at the manway opening or dome ring opening. For pressure class cars, "shell-full" includes the volume of all nozzles. A tank is "calibrated" to accurately determine its capacity. A tank is "gauged" to determine the quantity of liquid loaded into it. Shell-full stamping on tank car heads is net volume with allowance for tank internals displacement.

Tank Car "J" A tank car equipped with a thermal protection system and a safety relief valve with a defined minimum discharge capacity. "J" defines that the thermal protection system is covered with a steel jacket. All cars with a "J" designation are required to have head protection.

Tank Car "S" A tank car equipped with a DOT approved head shield. This car does not require thermal insulation.

Tank Car, Star Stencil When the tank car owner chooses to reduce the load limit from that shown for applicable axle size, a star symbol (*) must be applied immediately to the left of "LD LMT" stenciling. This fixed load limit must only be altered by car owner or by car owner's permission.

Tank Car, Sub Sill The tank car has draft sills attached directly to each end of the tank instead of a continuous center sill.

Tank Car "T" This is a car equipped with a thermal protection system with the required minimum safety relief valve capacity and a head shield. However, the "T" designation denotes a spray-on or rolled-on thermal protection system that is applied directly to the exterior of the tank. The material hardens and provides its own protective shell, and a steel jacket is not required.

Tank Cradle On underframe tank cars, the underframe structure, at the center of each truck, on which the tank sits.

Tank Dome A vertical cylinder attached to the top of a tank car. It permits the tank proper to be filled to full cubical capacity, which would be impossible if there were no dome.

Tank Head The circular, curved and/or elliptical pressed end sheet of a cylindrical tank.

Tank Head Brace A transition section, typically welded between the draft sill top member and a tank head pad to impart forces through the tank structure.

Tank Outlet (or Nozzle) A short pipe used to empty a tank. It is usually cast in one piece with the tank valve seat.

Tank Outlet Cap A screwed fitting attached to the bottom of a tank outlet for the purpose of closing it tightly.

Tank Outlet Reducer A reducer coupling, attached to a tank outlet, providing a connection for a smaller discharge fittings.

Tank Saddle The bearing structure which supports the tank. On some tank cars the saddle is also part of the body bolster.

Tank Test A periodic hydrostatic test of the tank required by the AAR and FRA.

Tank Valve Rod A steel rod for opening and closing a top operated bottom outlet valve, usually extending from the valve to the top of the tank.

Tank Valve Rod Bracket A brace in the tank through which the tank valve rod passes.

Tank Valve Rod Handle Or Wheel The operating lever at the top of the tank valve rod usually placed in the dome.

Tank Valve Rod Screw A screw on the end of a tank valve rod which passes through the tank valve rod nut and causes the valve to pen or close when the rod is turned.

Tank Valve A valve attached to the bottom of the tank to draw off the contents.

Tare Weight The weight of the empty car. The sum of the empty weights of the cars is the tare weight of the train.

TCC (Traction Control Converter) An electrical device that can covert AC to DC (dynamic brake and insert DC into AC traction power.

Telerail Automated Information Network (Train II) A system operated by the AAR which identifies boundary crossings.

Temperature Effect Change in temperature, produced by the expansion or contraction of air due to variation in pressure.

Temperature Sensing Equipment Part or parts which permit the determination of the temperature of the tank's contents.

Tender Drain Cup A small volume located in the brake pipe on a locomotive tender or power unit for the purpose of collecting dirt and moisture that would otherwise pass to the train where it might interfere with the normal operation of the brakes. It usually has a drain cock.

Tension Bar Any car subjected to a tensile stress such as the top cover plate of a built-up body bolster.

Tension Member Any structural member subjected to a tensile stress, such as the top cover plate of a built-up body bolster.

Test Code Instructions for determining the operating condition of a device.

Test Jacks Electric circuit terminals provided in speed governor and Decelostat relay cabinets for the purpose of establishing contact with the electric circuits of the test box when testing cars or trains equipped with either electric speed governor control or electric Decelostat control or both.

Test Rack A stationary arrangement of special test equipment, designed to test the operating devices of air brake equipment, either new or after cleaning or reconditioning, for the purpose of determining whether they are in condition to be placed in service.

Test Specifications (Test Code) Instructions governing the manner and procedure of testing air brake operating devices on specially designed test racks, and specifying the passing and condemning limits of the various device functions.

Test Truck A portable test device on wheels by which brake equipment on several cars may be checked to determine if the equipment is in suitable condition for continued service.

Test Weight Car A specially constructed car having a precisely known weight and used to verify the accuracy of railway scales.

TFM A disc brake system which incorporates the shoe support on the truck frame itself.

Thermal Brake Test For determining the comparative temperature of wheels that have been braked on a grade. Test is made by quickly touching the wheels. The heat of wheels or the absence of heat shows which have done braking and which have not.

Thermal Cracking A wheel defect characterized by fine cracks running transversely across the tread and caused by excessive heat generated at the tread surface during heavy prolonged braking. Undetected thermal cracks will propagate through the flange or rim into the wheel plate and cause failure.

Thermal Protection Insulation-type material applied to certain tank cars to minimize the potential for tank rupture due to flame impingement. Thermal protection does not qualify the tank for ambient temperature loading requirements.

Thermostat A device to control operation of equipment in response to changes in temperature.

Third-Rail Shoe A metallic sliding contact attached to the trucks of electric traction equipment for the purpose of collecting current from the third-rail distribution system.

Thread Protector In the form of metal caps, plugs, and discs, used to close the openings in various devices to protect the threads and prevent foreign matter getting inside the apparatus.

Three-Point Contact Bodily contact consisting of two hands and one foot or two feet and one hand.

Three-Stage Build-Up A feature of the AB freight car brake for controlling train slack that builds the brake cylinder pressure in three steps: a light (15 pound) inshot pressure in about a second or less, then at a slower rate, and a third build-up for a total of 10 seconds for the three stages.

Three-Stem Platform Equipment The conventional arrangement of buffing mechanism used in passenger train cars. It consists of a center stem within the platform, between the buffer plate and the buffing gear, which absorbs the buffing shocks. This is aided by two side stems and springs which act to keep the buffer plate in proper alignment.

Three-Way Cock Having three connections that may be connected together in pairs.

Threshold Plate In boxcar construction, a formed structural member extending across the door opening at the floor, and fitted at the door posts.

Throat In track nomenclature, the point where the converging wings of a frog are closest together just ahead of the frog point.

Throttle The regulating handle and connections that determine the amount of fuel entering an engine, thereby determining the engine and locomotive speed.

Throttle Notch One of nine discrete throttle positions allowed by the locomotive throttle handle. There are eight power positions, also called notches, plus idle position. Notch 8 is the full power position.

Thrust Collar A collar fastened to a shaft or axle by means of a set screw to prevent its shifting endwise.

Tie A beam or rod which secures parts together and is subjected to a tensile strain.

Tie Down Any device for securing a load to the deck of a car. Chain tie downs with ratchets are probably the most common type and are used to secure wheeled vehicles and lumber products on flat cars.

Tie Rod When used without specific reference, any rod or thin beam in a structure used to connect two other parts of the structure. Tie rods are usually, but not always, in tension.

Tight-Lock Coupler A special coupler for passenger cars that minimized slack for smoother train handling.

Timing The regular action of mechanically opening and closing the valves on an internal combustion engine. The movement is "timed" to coincide with events occurring in each cylinder and is controlled by the cam shaft.

Timing Reservoir Used with certain devices to time or limit their operation.

Timing Valve Used to control or limit the time of operation or flow of air.

TOFC (1) An acronym for "trailer on flatcar" intermodal service. (2) Truck on Flat Car.

Toggle Arms (Hopper Doors) The two arms of a toggle joint which form a strut between the two opposite hopper doors, holding them closed.

Tolerable Not too severe; within requirements of limitation as to shock, etc.

Tolerance The allowable variation from specified dimensions on a drawing.

Tonnage Rating The maximum trailing tonnage a locomotive can haul over the steepest grade of a railroad district or territory.

Tons per Effective Grade Brake The gross (load plus empty weight) tonnage of the train divided by the total number of cars having effective grade brakes. For example, total train weight 6,000 tons, total cars 100 with 90 effective grade brakes; divide 6,000 by 90 and there is slightly over 66 tons per effective grade brake.

Tons per Operative Brake The gross (load plus empty weight) tonnage of the train divided by the total number of cars having operative brakes. For example, total train weight 6,000 tons, total cars 100 all brakes operating; divide 6,000 by 100 and there is 60 tons per operative brake.

Top Chord The upper structural member of the side or end of an open top car, usually designed as a heavy channel or angle to withstand high bending stresses.

Top Connection The brake rod connecting the live truck lever with the body brake levers.

Top Plate One of the three primary components of a trailer hitch. The top plate is the horizontal component that contacts the trailer fifth wheel and secures the kingpin in any one of several jaws mechanisms. The top plate is sometimes known as the "head weldment."

Top Rod In freight car foundation brake rigging, the brake rod that connects the truck live lever to the body rigging system.

Top Style Safety Relief Valve A safety valve whose spring(s) is located above the valve seat thereby isolating the spring from the commodity. This valve is used to protect the spring from corrosion or where interior cleanliness is of prime importance.

Top Unloading Capability An assembly of valves used to unload a tank car from the top.

Top Walkway On cars equipped with end ladders, the walkway extending from the end ladders at each end of the car to the centrally located top operating platform.

Torque A term used to describe the twisting force required to turn a bolt or rotating shaft. Torque is measured in units of foot pounds (ft. lbs.) or inch pounds (in. lbs.) and is calculated by multiplying the applied force (in pounds) by the distance to its point of application (in feet or inches).

Torsional Vibration Oscillatory twisting vibration in a rotational direction which would tend to make a gear, mounted on one end of a shaft, whip back and forth with respect to a gear on the other end. See Critical Speed.

Total (Gross) Allowable Weight On Rail The maximum allowable weight of a car and lading on rail or as indicated in UMLER. See Rule 91, AAR Field Manual. Also referred to as gross rail load.

Tower Car A rail vehicle, the propulsion of which is effected by electric means and that is provided with an elevated platform, generally arranged to be raised and lowered, for the installation, inspection, and repair of a contact wire system.

Track Car Any equipment operated on track, such as motor car, hand car, trailer, or other unit not on standard railcar trucks.

Track Geometry Car A passenger car equipped with necessary instrumentation to provide quantitative track evaluations.

Track Inspection Car A passenger car used in regular consists from which the track may be inspected but not necessarily containing track geometry evaluation equipment.

Track Structure The railroad track comprised of rail, tie plated fasteners, cross tires, ballast, and subgrade.

Track-Train Dynamics The study of the motions and resulting forces that occur during the movement of a train over a track under varying conditions of speed, train makeup, track and equipment conditions, grades, curves and train handling.

Traction Motor A specially designed direct current series wound motor mounted on the trucks of locomotives and self-propelled cars to drive the axles. An electric motor which, through an arrangement of mechanical gears, imparts rotary motion to a pair of wheels and an axle of the locomotive.

Tractive Effort The force (at the wheel/rail interface) at a given speed the locomotive exerts to move itself and any coupled cars.

Trailer A cargo carrying highway vehicle without automotive power. Trailers are usually hauled by a powered vehicle called a tractor. Trailers became of major importance to the railroad industry with the introduction of piggyback or TOFC service.

Trailer Car A four-wheeled work car equipped with a seat, foot boards, safety rails and brakes. Used for transporting men, and may be converted into a push car by removing the seat, foot boards and railings.

Trailer Hitch A specially designed device mounted on a TOFC car for the purpose of supporting and securing highway trailers during rail transit. Trailer hitches may either be rigid or cushioned, and they may or may not be retractable, depending on their intended service.

Trailing Foot Foot nearest to the approaching equipment. (For example, if you are facing the track and the rail equipment is approaching or passing from the left to right, your left foot is the trailing foot.)

Trailing Unit See "B" Unit.

Train An engine or more than one engine coupled, with or without cars, displaying markers. For practical purposes, a train is a group of coupled cars hauled by a locomotive.

TRAIN (AAR) The name given to a computerized car movement system coordinated by the Association of American Railroads for furnishing information to member railroads about movement of their cars throughout the country.

Train Air Signal In passenger trains, a means of signaling the locomotive engineman from any car in the train using a separate air line (the signal line) connected between the cars and running the length of the train. Operation of a conductor's valve, usually located in the vestibule of each car, causes a high pitched "beep" tone in the locomotive cab, alerting the engineman to take some predetermined action.

Train Brake The automatic brake. The combined brakes on locomotive and cars that provides the means of controlling the speed and stopping of the entire train.

Train Consist The composition of the complete train excluding the locomotive. The cars in a train.

Train Control An automatic operation brought about by a combination of devices to cause brakes to apply on a train, unless prevented by the engineer, under restricted signals or when a maximum speed is exceeded.

Train Efficiency The number of ton miles of train moved divided by the number of gallons of fuel required to complete the movement.

Train Handling Techniques The procedures used by the locomotive engineer to operate the locomotive throttle and brake systems to permit train movement while preventing the development of excessive and damaging drawbar forces.

Train Line A term properly applied to describe the continuous line of brake pipe extending from the locomotives to the last car in a train, with all cars and air hoses coupled. The term is often used to refer to the brake pipe on a single car.

Train Makeup The composition of a train, including number and style of cars and locomotive units. May also be referred to as train consist.

Train Meet The process whereby two trains moving in opposite directions on single track may safely meet and pass one-another, one of them taking a side track during the process.

Train Mile The movement of a train a distance of one mile measured by the distance between terminals and/or stations and includes yard switching miles, train switching miles, and work train miles. Yard switching miles may be computed on any reasonable, supportable, and verifiable basis. In the event actual mileage is not computable by other means, yard switching miles may be computed at the rate of 6 mph for the time actually engaged in yard switching service.

Train or Yard Crew One or more railroad employees assigned a controlling locomotive, under the charge and control of one crew member, called to perform service covered by Section 2 of the Hours of Service Act; involved with the train or yard movement of railroad rolling equipment they are to work with as an operating crew; reporting and working together as a unit that remains in close contact if more than one employee; and subject to the railroad operating rules and program of operational tests and inspections required. Also see Utility Employee.

Train Resistance A force which resists or opposes movement of a train. Resistance to motion along the track, attributed to bearings, wind and air resistance, flange contact with rail ,etc.

Tramway See Rail, Light.

Transfer Center A fixed location where passengers interchange from one route or vehicle to another.

Transfer Valve A device used with KD and AB 4-12 equipment that controls the flow of air to the 4-inch cylinder and between the 4- and 12-inch cylinder. Also the name of a device used on long locomotives with double-end equipment.

Transit See Public Transportation.

Transit 2000 An industry effort undertaken in the late 1980s to develop public policies allowing transit to achieve its greatest potential for the rest for the 20th century and beyond; recommendations included turning transit system into managers of mobility, broadening transit's definition to include ridesharing and other high occupancy vehicle programs, enhancing local decision-making authority, increasing federal funding and raising the federal gasoline tax.

Transit Pass A tax-free employee commute benefit in which an employer subsidizes up to $60 per month for an employee's transit fares or vanpool charges. This benefit also applies to military and government employees.

Transit System An organization (public or private) providing local or regional multi-occupancy-vehicle passenger service. Organizations that provide service under contract to another agency are generally not counted as separate systems.

Transition Changes in a diesel electric locomotive's traction motor circuits from series, to series-parallel, to parallel, to enable the locomotive to operate within the limits of its speed range without overloading the electrical equipment.

Transom A truck cross member which performs the function of tying together the side frames and providing support for the bolster. Now practically extinct in freight car trucks.

Transport The movement of goods and material in commerce.

Transport Workers Union (TWU) One of the major labor unions in the transit industry; membership is limited to operators, mechanics and other non-supervisory employees of the transit industry.

Transportation Condition Code Alphabetic code describing an AAR or FRA interchange restriction as defined in Exhibit P of the UMLER Date Specification Manual.

Transportation Improvement Program (TIP) A program of intermodal transportation projects, to be implemented over several years, growing out of the planning process and designed to improve transportation in a community. This program is required as a condition of a locality receiving federal transit and highway grants.

Trap In pipe fitting work, an arrangement of a pipeline to catch or retain a portion of the fluid flowing in the system.

Trap Door A door in a floor or roof, closing flush when shut. On passenger cars, a door over the steps in the vestibule, making a full width platform when the door is closed.

Tread In car wheel nomenclature, the slightly tapered exterior running surface of the wheel that comes in contact with the top surface of the rail, and also serves as a brake drum on cars with conventional brake arrangements. In rail nomenclature, the top surface of the rail which contacts the vehicle.

Tread Brakes Those wherein the brake shoes bear against the tread of the wheel when brakes are applied.

Treads (Ladder) The horizontal bars on which the foots rests.

Tri-Level Car A flatcar designed with integral superstructure of posts, bracings and decking to permit triple level loading of automobiles. The deck of the underframe serves as the lower deck of the superstructure.

Trip A movement of a locomotive over all or any portion of automatic train stop, train control or cab signal territory between the terminals for that locomotive; a movement in one direction.

Trip Switch Located on a car truck to provide an emergency application of brake in the event the car runs past a signal stop indication.

Triple-Net Lease A lease where the lessee pays all taxes, maintenance, repair, and insurance in addition to a monthly lease rate.

Triple Valve An operating valve for charging the reservoir, applying the brake, and releasing the brake.

Trolley A term referring to an overhead electric contact wire on electric railroads or transit systems.

Trolley Car (1) An electric motor car that collects propulsion power from a trolley system. (2) See Rail, Light.

Trolley Shoe A sliding metallic contact piece for collecting current from an overhead wire. Also called "contact shoe."

Trolley Wire On electrified railroads, a term used to describe the overhead wire used to distribute electric current to locomotives or other traction equipment. A more proper term for an overhead electric current distribution system is "catenary."

Truck The complete assembly of parts including wheels, axles, bearings, side frames, bolster, brake rigging, springs and all associated connecting components, the function of which is to provide support, mobility and guidance to a railroad car.

Truck Bolster The main transverse member of a truck assembly that transmits carbody loads to the side frames through the suspension systems. The ends of the bolster fit loosely into the wide openings in the side frames and are retained by the gibs, which contact the side frame column guides. Truck bolster contact with the carbody is through the truck center plate, which mates with the body center plate and through the side bearings.

Truck Center Plate The circular area at the center of a truck bolster, designed to accept the protruding body center plate and provide the principal bearing surface for carbody support on the truck bolster. Truck center plates are often fitted with a horizontal wear plate and a vertical wear ring to improve wearing characteristics end extend bolster life.

Truck Centers On a single car, the distance between the truck center pins as measure along the center sill from the center line of one body bolster to the center line of the other. See Center Pin.

Truck Frame A structure made of cast steel in one piece, to which the journal boxes or pedestals, springs and other parts are attached, and which forms the skeleton of a truck. One piece truck frames are not generally used for freight cars, but are often found on locomotives and passenger cars.

Truck Hunting A lateral instability of a truck, generally occurring at high speed, and characterized by one or both wheelsets shifting from side to side with the flanges striking the rail. The resulting motion of the car causes excessive wear in car and truck components, and creates potentially unsafe operating conditions. For freight vehicles, the phenomenon occurs primarily with empty or lightly loaded cars with worn wheelsets.

Truck Lever Connection A rod or bar connecting the brake levers on the truck brake gear.

Truck Mounted Brake A method whereby a freight car brake system places the brake cylinders directly on the car truck and eliminates all of the mechanical foundation brake rigging connections between the carbody and the truck. Air from the control valve is connected by a suitable hose or hoses. Hand brake connections are still maintained but usually on one truck only. See Nycopak, Wabcopac.

Truck Mounted Brakes An air brake system whose cylinder(s) are mounted on the trucks, thereby eliminating the need for mounting rods, levers, and a slack adjuster directly to the underside of the car. Generally used to provide clearance under the side.

Trucks, Radial Railroad freight car trucks whose wheelsets are suspended in the truck frame in such a way as to allow the wheelsets to align themselves to the radius of a curve in the track. This is usually accomplished by low yaw constraints between the wheelsets and truck frame, together with inter-connections between the wheelsets for good hunting stability.

Truck Side See Side Frame.

Truck Side Bearing A plate, block roller or elastic unit fastened to the top surface of a truck bolster on both sides of the center plate, and functioning in conjunction with the body side bearing to support the load of a moving car when variations in track cross level cause the carbody to rock transversely on the center plates. See Body Side Bearing, Side Bearing and Side Bearing Roller.

Truck Springs A general term used to describe any of the several types of springs used in the suspension system of trucks to provide a degree of vertical cushioning to the car and its load.

Truck Wheel Base The horizontal distance between the centers of the first and last axles of a truck.

Trunnion A cylindrical projection on the side of any part that allows a turning or oscillating movements.

Truss An engineering term used to describe a built-up structural frame where the members are straight bars or beams arranged in such a manner that when the structure is loaded, the individual members are theoretically subjected only to tensile or compressive stresses. Some freight car sides are designed as trusses.

Trust Funds Funds collected and used by the federal government for carrying out specific purposes and programs according to terms of a trust agreement or statute, such as the Social Security and highway trust funds. Trust funds are administered by the government. See Dedicated Funding Source.

Trust Plate A metal plate attached to a piece of railroad equipment to identify the trustee (usually a bank) holding title to the equipment pursuant to an equipment trust agreement.

Turbocharger A centrifugal blower driven by an exhaust gas turbine used to supercharge an engine.

Turnbuckle An elongated sleeve with a right-hand thread at one end and a left-hand thread at the other for the purpose of tightening the connection between two rods with threaded ends.

Turntable A circular platform with a track section extending across its diameter, pivoted at the center, and used for turning locomotives around at terminals.

Two-Application Stop Where the brake is applied with heavy reduction at high speed, then released and reapplied at a comparative slow speed with a lighter reduction which may be released before or at the time of stopping passenger trains, depending upon the length of train.

Two-Stroke Cycle The operating cycle of an internal-combustion engine in which there is one power stroke during each revolution of the crankshaft.

U

U-Bolt A fastening device consisting of a rod bent into the shape of a capital "U" with the straight portions threaded on the ends to accept nuts.

UC (Universal Control) An older form of air brake control valve.

Ultrasonic Inspection A method for inspection for internal defects in material using ultrasonic sound waves and electronic measuring equipment. Common railroad applications are inspection of axles and wheel rims.

Ultrasonic Test A test made to detect subsurface discontinuity.

UMLER Acronym for Universal Machine Language Equipment Register. A computerized file maintained by the Operating Transportation Division of the Association of American Railroads. UMLER contains specific details on internal and external dimensions of equipment as well as special equipment and the general information shown in *The Official Railway Equipment Register.*

Unacceptable Welding Defect Any weld defect that exceeds the standards contained in Appendix W of the AAR Specifications for Tank Cars, M-1002.

Unauthorized Modification Improper use of tools and/or equipment for the job task. Unauthorized modifications include actual physical alteration of tools or equipment and use of tools or equipment for other than their intended purpose.

Uncoupling Chain A short chain connecting the coupler lock with the uncoupling lever.

Uncoupling Lever Bracket A bracket supporting the uncoupling lever on the end of the car.

Uncoupling Lever or Rod The manually operated mechanical device mounted at each end of a railcar used to unlock and open the coupler. The general term used to describe any of the several types of safety appliance when it is desired to separate coupled cars. Uncoupling levers are mounted on the end sill near the side sill to enable manual operation without stepping between the cars.

Undercharge Where the brake equipment is not fully charged.

Undercut In welding processes, a groove melted into the base metal adjacent to the toe of the weld, and left unfilled by weld metal. Severe undercutting of welded joints results in a weakening of the parent metal, and sets up a potential structural failure.

Underframe (1) The term used to refer to the entire structural framework of the car below the floor, including the center sill, side and end sills, bolster, cross members, stringers and other attached components. (2) The supporting matrix in the understructure. Generally the body bolsters, sills, platforms, floor stringers, cross bearers and cross ties that support the superstructure.

Understructure The assembled parts below the superstructure including the underframe, trucks, wheels, draft gear, coupler, center sill, body bolsters, floor stringers, side sills, crossties and running gear. See Underframe.

Unfair Usage Damage or loss to any freight car as specified in Rule 95, AAR Field Manual.

Uniform Charge, or Uniform Recharge The feature provided to overcome the tendency of the brake equipment to become charged or recharged quicker on the apparatus nearest the source of supply (usually the locomotive).

Uniform Release (Also called Retarded Release) A feature to restrict the release of brake cylinder air on the front 25 to 30 cars of a train so that by the time the brake pipe pressure is increased on the rear of train (60- to 75-car trains) all brakes should be released at approximately the same time.

Unit A locomotive unit. See Locomotive Unit.

Unit(s) A car, multi-unit car, articulated car, or multi-level superstructure which is identified by a unique reporting mark and number.

Unit Train A train transporting a single commodity from one source (shipper) to one destination (consignee) in accordance with an applicable tariff.

United Transportation Union (UTU) One of the major labor unions in the transit industry; membership is limited to operators, mechanics and other non-supervisory employees of the transit industry.

Universal Hose and Pipe Coupling A fitting which permits quick connecting and disconnecting of hose-to-hose, hose-to-pipe, and hose-to-tool.

Universal Joint A device for connecting the ends of two shafts so as to allow them to have flexibility in every direction within certain defined limits.

Universal Machine Language Equipment Register (UMLER) A computer file which contains specific details such as internal and external dimensions, carrying capacities, and equipment weight for freight cars. See Rule 93, AAR Field Manual.

Universal Valve An operating valve for passenger cars for charging, applying, and releasing brakes. At the time it was introduced it had features beyond the previous L triple valve (of separated service and emergency operation); universal in that different sizes were not necessary but chokes were used to control flow of air to and from brake cylinders.

Unloading Allowance The amount of compensation allowed for unloading damaged equipment from other equipment. Job Code 4488, Rule 75, *AAR Field Manual* of the AAR Interchange Rules.

Unsafe Condition Any physical state which results in a reduction in the degree of safety normally present in an activity.

Urban Mass Transportation Administration (UMTA) See Federal Transit Administration Act (FTA).

Urbanized Area An US Bureau of Census-designated area of 50,000 or more inhabitants consisting of a central city or two adjacent cities plus surrounding densely settled territory, but excluding the rural portion of cities.

Utility Employee A railroad employee assigned to and functioning as a temporary member of a train or yard crew whose primary function is to assist the train or yard crew in assembly, disassembly or classification of rail cars, or operation of trains (subject to the conditions set forth by FRA). Also see Train or Yard Crew.

V

Vacuum Brake A railroad brake system used mainly outside the United States, actuated by exhausting air from a device on each car to make use of atmospheric air to apply the brakes.

Vacuum Relief Valve A spring loaded valve, mounted at the top of some tank and hopper cars, designed to open and allow air into the tank if an excessive internal vacuum occurs.

Valve In its most general sense, any device that opens and closes openings to control flow of a fluid or gas for some purpose air brake valves operate in many ways to control flow of air in air brake systems; intake and exhaust valves operate to admit fuel-air mixtures and expel products of combustion in engine cylinders.

Valve Seat The part of an apparatus in contact with the valve, and which acts with the valve to seal the opening.

Valve Stem A movable shaft that transmits the operating force to the valve closure member.

Valves and Fittings Those appurtenances, including secondary valves, attached to a tank car tank by bolting, threading or welding, designed to control flow of fluids into and out of the tank; measure fluid pressure and temperature; sample fluids in the tank; detect or determine liquid levels; or relieve over-pressures for purposes of emergency relief or temperature control. Valves and fittings require Tank Car committee approval, using procedures in M-1002 Part 1.4 and Appendix A of AAR regulations. Those nozzles and mountings welded directly to the tank to mount fittings are not defined as fittings themselves. Closures, such as blind flanges, caps and plugs, are not fittings.

Van See Caboose.

Vanpool An arrangement in which a group of passengers share the use and cost of a van in traveling to and from prearranged destinations together.

Van-Type Train A train primarily carrying highway trailers on flat-cars (TOFC) or carrying containers on flat.

Vapor Capture System Any combination of hoods and ventilation system that captures or contains organic vapors in order that they may be directed to an abatement or recovery device.

Vapor Valve Any valve which is opened or closed manually or automatically to permit the passage of vapor into or out of the tank.

Variable Cost A cost that varies in relation to the level of operational activity.

Variable Release Valve In addition to the features of a release valve, it has an increased capacity for exhausting the air from the auxiliary reservoirs at a rapid rate.

Variable Type Release Valve One having a normal opening for draining if the valve is opened fully.

Vehicle Passenger car, freight car, locomotive, motor car, etc.; a general name to include any of the various means of hauling or the power units used on the railroad trains.

Vent A small aperture; a hole or passage for air or other fluid to escape.

Vent Valve A device operating when an emergency rate of brake pipe reduction is made, causing a large opening from the brake pipe to the atmosphere in order to pass quick action to adjoining devices. Usually the opening is made for a definite length of time.

Ventilated Boxcar An ordinary boxcar arranged for ventilation and suitable for the transportation of produce or other food stuffs not requiring refrigeration.

Vertical Bounce An instability at high speed where the vehicle oscillates vertically on the suspension system.

Vertical Strut One of the three main members of a piggyback trailer hitch. The vertical strut serves to support the weight of a trailer, and has pinned connections at the head, on the deck of the car and at the diagonal strut to enable the entire assembly to be retracted to the deck when not in use.

Vertical Wheel Hand Brake A type of hand brake mechanism having the hand wheel positioned vertically and mounted on a gear housing which is fastened to the car end. See Horizontal Wheel Hand Brake.

Vestibule An enclosed space at each end of a passenger car.

Viscosity A property of a fluid relating to its ability to flow, particularly at low temperatures.

Visual Gauge Bar On non-pressure tank cars, a bar mounted to the inside of the tank and which is visible through the manway when open. Markings on the bar indicates various liquid and outage levels.

Visual Inspection A non-destructive test method using ordinary vision to detect surface imperfections in materials and welds.

Volt The unit of electromotive force that, when impressed on an electrical conductor, whose resistance is 1 ohm, will produce a current of 1 ampere.

Voltage A unit of electromotive force which causes electrical current to flow in a conductor. One volt will cause an electrical current of one ampere to flow through a resistance of one ohm.

Voltage Drop The decrease in voltage to a current carrying conductor.

Voltmeter An instrument for measuring in terms of volts the electromotive force of an electric current.

Volume (1) A reservoir, such as a space within a casting, within pipes, or within cylinders, capable of pressurized air for brake purpose. (2) The interior dimensions of, or space within, such reservoir. (3) The mass or quantity of air.

Volume Reservoir Used to provide required stability for the operation of a piston or valve.

Volute Spring A spring made by winding a flat steel strip in a close spiral scroll so that axial movement of the spring is partially restricted by the friction between adjacent coils. Volute springs are sometimes used in spring groups to assist in controlling excessive lateral rocking of cars.

W

WABCO A registered trade mark (initials of Westinghouse Air Brake Co.), originally for special rubber products such as Wabco gasket.

Wabco Cup A registered trade mark name for a piston packing that fits over the entire face of the piston with a cupping at the edges to make an airtight fit for brake cylinders, etc.

Wabco Gasket A registered trade mark name for a rubber or composition ring or disc to make an airtight joint.

Wabcogrip Fittings A registered trade mark name for a pipe fitting used for quick repair of broken air pipes.

Wabcolite Bushing A registered trade mark name for a composition bushing used for piston cylinders such as the operating valves on cars and locomotives.

WABCOPAC A proprietary name for a truck mounted brake system (manufactured by Westinghouse Air Brake Company) in which the brake cylinder is made integral with the brake beam. Later versions use only one brake cylinder per truck and incorporate an automatic slack adjuster.

Wabco Packing Ring A registered trade mark name for a rubber or composition ring that will make an airtight joint when properly held in position.

Wabcoseal Fitting A registered trade mark name of a flange type fitting similar to the Wabcotite fitting except that pipe threading is not required.

Wabcote Protective coating material.

Wafersphere Valve A 6" butterfly style bottom outlet valve manufactured by Neles-Jamesbury, Inc.

Washout Nozzle A removable plug arrangement at the bottom of a tank to facilitate cleaning cars which are not permitted to have a bottom unloading valve.

Wasp Excluder A device for preventing insects from entering openings in air brake equipment where they build obstructions which interfere with the functioning of the equipment.

Water Brake Water from the boiler is opened into the locomotive exhaust passages with the locomotive valve gear reversed. The partial vacuum in the steam cylinders causes the water to form low-pressure steam and prevent hot gases from front end of engine to enter. This low-pressure steam in the cylinders provides retardation through the drivers.

Water Capacity The number of gallons of water a tank will hold at a water temperature of 60 degrees Fahrenheit.

Water Jacket An enclosed space surrounding the cylinder liner of an engine through which water circulates to prevent overheating. Its enclosure may be separate from an integral part of the cylinder liner casting.

Water-Tube Boiler A boiler in which water circulates through tubes surrounded by hot gases which are the products of combustion in the firebox.

Way Car See Caboose.

Wearplate A renewable plate of hardened steel or other material designed for application to the surface of another component exposed to conditions causing severe wear.

Web In a structural beam such as an I-beam or channel, the web is the center element between the two flanges. In a built-up beam such as a car center sill, the web plates are the vertical members between the top and bottom cover plates. The web of a rail is the center element between the head and the base.

Weld A seam where two members are joined, formed by any of several heating processes resulting in melting and fusing together of the metal on either side of the joint, often with the addition of filler metal to improve the properties of the joint. Welding processes are extremely important in modern car construction.

Weld Bead A weld deposit resulting from a pass.

Welder A person who joins metal parts by the application of a fusion process, either manually or with semi-automatic welding equipment.

Welder Certification Certification in writing that a welder has produced welds meeting prescribed standards.

Welder Performance Qualification The demonstration of a welder's ability to produce welds meeting prescribed standards.

Weld Face The exposed surface of a weld on the side from which welding was done.

Welding The process of joining two members by the addition of heat and filler metal.

Welding Operator A person who operates machine or automatic welding equipment, in which both the rate of travel and position of welding head with respect to the work are controlled mechanically, except for minor adjustments.

Welding Procedure Specification (WPS) A document prepared to provide direction to the welder, or welding operator, making production welds to appendix W requirements of AAR Field Manual. The WPS describes in detail all the variables which are essential and nonessential to the welding process.

Welding Rod In manual arc welding processes, the term commonly used to refer to the electrode that contacts the pieces to be joined, and is consumed in the welding process. Technically, the term properly refers to filler metal, in wire or rod form, used in any of the several welding processes.

Weld Layer A stratum of weld metal consisting of one weld bead of multiple weld beads placed side by side.

Weldment An assembly whose component parts are joined by welding.

Weld Pass A single progression of welding or surfacing along a joint or substrate. The result of a pass is a weld bead, layer or spray deposit.

Weld Root The point at which the back of the weld intersects the base metal surfaces.

Weld Slag Amorphous deposit formed during welding.

Weld Splatter Beads of metal left adjoining the weld.

Weld Toe The junction of the weld face and the base metal.

Well Car A flatcar with a depression or opening in the center to allow the load to extend below the normal floor level when it could not otherwise come within the overhead clearance limits.

Well Injection The subsurface emplacement of fluids in a well.

Wheel The specially designed cast or forged steel cylindrical element that rolls on the rail, carries the weight and provides guidance for rail vehicles. Railway wheels are semi-permanently mounted in pairs on steel axles, and are designed with flanges and a tapered tread to provide for operations on track of a specific gage. The wheel also serves as a brake drum on cars with on-tread brakes.

Wheel Base The horizontal distance between centers of the first and last axles of a locomotive or car.

Wheel Bore The hole through the hub of the wheel which is machined to precise dimensions to create a press fit on the axle wheel seat.

Wheel Burn Damage to the tank shell or jacket due to frictional contact with a rotating wheel, resulting in metal flow and/or discoloration due to frictional heat.

Wheel Cleaner Each wheel is shot blasted to improve its surface appearance.

Wheel Creep An operating condition wherein the wheel is not purely rolling on the rail, yet, it is not purely slipping on the rail. The coefficient of friction between wheel and rail is greatest in this transition between purely rolling and purely slipping.

Wheel Fit See Wheel Seat.

Wheel Flange The tapered projection extending completely around the inner rim of a railway wheel, the function of which, in conjunction with the flange of a mate wheel, is to keep the wheel set on the track by limiting lateral movement of the assembly against the inside surface of either rail.

Wheel Grinding A process of refining the tread contour of steel railway wheels by rotating them against a grinding wheel under precise controls.

Wheel Peener A process to induce compressive stresses on plate surface of wheel.

Wheel Plate The part of a railway wheel between the hub and the rim.

Wheel Pull Caused by the friction between the brake shoe and the wheel and transmitted to the rail.

Wheel Rolling The wheel rotating on its axle theoretically without motion existing between the wheel and the rail at the area of contact.

Wheel Seat The term used to describe a pair of wheels mounted on an axle.

Wheel Sliding The wheel not rotating on its axis and motion existing between the wheel and rail at the area of contact.

Wheel Slip An operating condition wherein there is wheel rotation on its axis with motion of the wheel at the point of contact with the rail. Wheel rotation speed during wheel slip is greater than it is during rolling.

Wheel Slipping The wheel rotating on its axle with motion existing between the wheel and rail at the area of contact.

Wheel Slip Relay An electrical device which senses a slipping wheel, and causes a reduction of power, provides automatic sanding and activates a wheel slip indicator in the locomotive cab.

Wheel Transfer Depending upon wheel type, the wheel casting will solidify in 7 to 12 minutes. The cope (top) of the mold is removed, and the wheel is lifted by the hub and conveyed to the final finishing and inspection stations.

Wheel Tread The slightly tapered or sometimes cylindrical circumferential surface of a railway wheel that bears on the rail and serves as a brake drum on cars with conventional truck brake rigging. See Tread.

Wheel Truing Brake Shoe A special brake shoe with abrasive inserts to grind the wheel tread and flange to true contour when brake applications are made in service.

Why Made Code Numeric code used to designate the reason repairs were made or services performed.

Wide-Body Rack A fully-enclosed auto rack superstructure that is wider than earlier rack types so as to provide greater interior width.

Wide Gage In general usage, the distance between the heads of the rails of a railroad when it is significantly greater than 4'8½", in contrast to broad gage, which means a material increase, as to 5'6" or 6'.

Windshield The combination of individual units of glazing material of the locomotive, passenger car, or caboose that are positioned in an end facing glazing location.

Witness An individual who has, from personal observation, knowledge of an event.

Women's Business Enterprise (WBE) A business owned and operated by one or more women.

Woodchip Hopper Open-top car with interior slope sheets and gates used to transport woodchips.

Work The force exerted on an object multiplied by the distance the object moved. The work a locomotive does is the tractive effort of the locomotive multiplied by the distance the train moved as a result of the tractive effort.

Wrecking Crane A heavy crane mounted on rail trucks, usually powered by a diesel engine for use in clearing up wrecks. Frequently called "wrecker."

Wreck Repair A repair performed as a result of unfair usage damage sustained in a derailment, sideswipe, collision, etc.

Wrench Clearance The space around an emplaced nut or bolt head, to allow proper use of the correct wrench.

Wrought Steel Wheel A railway wheel made by hot forging and rolling as opposed to the pressure casting process.

Wye A term used to describe a track arrangement shaped like the letter"Y" but with a connecting segment between the upper legs. This track layout is often used in small yards and at some rip tracks to enable equipment to be turned without a turntable.

Work Environment The physical location, equipment, materials processed or used, and the kinds of operations performed in the course of an individual's work, whether on or off the company's premises.

Y

Yard A system of auxiliary tracks used exclusively for the classification of passenger or freight cars according to commodity or destination; assembling of cars for train movement; storage of cars; or repair of equipment.

Yard Engine An engine assigned to yard service and working wholly within yard limits.

Yard Plant A system of piping and fittings installed between the tracks in such a manner that air supply can be furnished at convenient locations for charging when making tests on cars previous to a locomotive being available. A yard plant is to make possible the terminal tests before arrival of the locomotive that will haul the train.

Yoke The component in a railroad car draft system that transmits longitudinal coupler forces to the draft gear. See Coupler Yoke.

Z

Zee Bar See Zee Section.

Zee Section A commercial rolled steel structural member, so called because of the shape of its cross section. Zee sections are often used as floor stringers in box and gondola car construction. Two (2) Zee sections are used to make a center sill or stub sill.

Zone Fares A system of fares where a transit system's service area is divided into zones within which specified rates or fares apply.

Designation: A 480/A 480M – 05

Standard Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet, and Strip[1]

This standard is issued under the fixed designation A 480/A 480M; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

This standard has been approved for use by agencies of the Department of Defense.

1. Scope*

1.1 This specification[2] covers a group of general requirements that, unless otherwise specified in the purchase order or in an individual specification, shall apply to rolled steel plate, sheet, and strip, under each of the following specifications issued by ASTM: Specifications A 167, A 176, A 240/A 240M, A 263, A 264, A 265, A 666, A 693, A 793, and A 895.

1.2 In the case of conflict between a requirement of a product specification and a requirement of this specification, the product specification shall prevail. In the case of conflict between a requirement of the product specification or a requirement of this specification and a more stringent requirement of the purchase order, the purchase order shall prevail. The purchase order requirements shall not take precedence if they, in any way, violate the requirements of the product specification or this specification; for example, by waiving a test requirement or by making a test requirement less stringent.

1.3 The values stated in either inch-pound units or SI units are to be regarded separately as standard. Within the text, the SI units are shown in brackets, except that when A 480M is specified, Annex A3 shall apply for the dimensional tolerances and not the bracketed SI values in Annex A2. The values stated in each system are not exact equivalents; therefore, each system must be used independently of the other. Combining values from the two systems may result in nonconformance with the specification.

1.4 This specification and the applicable material specifications are expressed in both inch-pound and SI units. However, unless the order specifies the applicable "M" specification designation [SI units], the material shall be furnished in inch-pound units.

2. Referenced Documents

2.1 *ASTM Standards:* [3]

A 167 Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip

A 176 Specification for Stainless and Heat-Resisting Chromium Steel Plate, Sheet, and Strip

A 240/A 240M Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications

A 262 Practices for Detecting Susceptibility to Intergranular Attack in Austenitic Stainless Steels

A 263 Specification for Stainless Chromium Steel-Clad Plate

A 264 Specification for Stainless Chromium-Nickel Steel-Clad Plate

A 265 Specification for Nickel and Nickel-Base Alloy-Clad Steel Plate

A 342/A 342M Test Methods for Permeability of Feebly Magnetic Materials

A 370 Test Methods and Definitions for Mechanical Testing of Steel Products

A 666 Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar

A 693 Specification for Precipitation-Hardening Stainless and Heat-Resisting Steel Plate, Sheet, and Strip

A 700 Practices for Packaging, Marking, and Loading Methods for Steel Products for Domestic Shipment

A 751 Test Methods, Practices, and Terminology for Chemical Analysis of Steel Products

A 763 Practices for Detecting Susceptibility to Intergranular Attack in Ferritic Stainless Steels

A 793 Specification for Rolled Floor Plate, Stainless Steel

A 895 Specification for Free-Machining Stainless Steel Plate, Sheet, and Strip

[1] This specification is under the jurisdiction of ASTM Committee A01 on Steel, Stainless Steel and Related Alloys and is the direct responsibility of Subcommittee A01.17 on Flat-Rolled and Wrought Stainless Steel.

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[2] For ASME Boiler and Pressure Vessel Code applications see related Specification SA – 480 in Section II of that Code.

[3] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

***A Summary of Changes section appears at the end of this standard.**

A 923 Test Methods for Detecting Detrimental Intermetallic Phase in Wrought Duplex Austenitic/Ferritic Stainless Steels
E 140 Hardness Conversion Tables for Metals Relationship Among Brinell Hardness, Vickers Hardness, Rockwell Hardness, Superficial Hardness, Knoop Hardness, and Scleroscope Hardness
2.2 *AIAG Standard:*[4]
B-5 Primary Metals Identification Tag Application Standard
2.3 *ANSI Standard:*[5]
Accredited Standards Committee X 12, (ANSI ASC X12)
2.4 *Federal Standard:*[6]
Fed. Std. No. 123 Marking for Shipment (Civil Agencies)
2.5 *Military Standards:*[6]
MIL-STD-129 Marking for Shipment and Storage
MIL-STD-163 Steel Mill Products, Preparation for Shipment and Storage

3. Terminology

3.1 *Definitions:*
3.1.1 Plate, sheet, strip, and cold work as used in this specification apply to the following:
3.1.2 *plate*—material 3⁄16 in. [5.00 mm] and over in thickness and over 10 in. [250 mm] in width. Finishes for *plate* are actually shown in Section 13.
3.1.3 *sheet*—material under 3⁄16 in. [5.00 mm] in thickness and 24 in. [600 mm] and over in width. Finishes for *sheet* are actually shown in Section 11.
3.1.4 *strip*—cold-rolled material under 3⁄16 in. [5.00 mm] in thickness and under 24 in. [600 mm] in width. Finishes are detailed in Section 12 for *strip*, and strip edges in Section 14 for Cold-Rolled Strip.
3.1.5 *cold work*—the changing of mechanical properties by work hardening.

4. Ordering Information

4.1 It is the responsibility of the purchaser to specify all requirements that are necessary for material ordered under this specification. Such requirements may include, but are not limited to, the following:
4.1.1 Quantity (weight and number of pieces),
4.1.2 Name of material (stainless steel),
4.1.3 Condition (hot-rolled, cold-rolled, annealed, heat-treated),
4.1.4 Finish (see Section 11 for Sheet, Section 12 for Strip, and Section 13 for Plates). In the case of polished finishes, specify whether one or both sides are to be polished,
4.1.5 Temper (if the applicable material specification requires this detail),
4.1.6 Form (plate, sheet, or strip),
4.1.7 Dimensions (thickness, width, length),
4.1.7.1 Thickness shall be ordered to decimal or fractional thickness. The use of the gage number is discouraged as being an archaic term of limited usefulness not having general agreement on meaning. The gage number shall not be a basis for rejection.
4.1.7.2 Thickness, width, and length, when applicable, should be ordered in the same units, for example, 0.060 in. by 48 in. by 120 in. [1.52 mm by 1219 mm by 3048 mm].
4.1.8 Edge, strip only (see Section 14 for Cold-Rolled Strip),
4.1.9 Type or UNS designation, refer to the applicable material specification,
4.1.10 Specification designation and date of issue,
4.1.11 Additions to specification or special requirements,
4.1.12 Restrictions (if desired) on methods for determining yield strength (see appropriate footnote to mechanical properties table of the basic material specification),
4.1.13 Marking requirements (see Section 25),
4.1.14 Preparation for delivery (see Section 25), and
4.1.15 Magnetic permeability test (when required). Refer to Section 19.

NOTE 1—A typical ordering description is as follows: 200 pieces, stainless steel sheets, 0.060 in. by 48 in. by 120 in., Type 410 No. 2B finish, ASTM A 176-XX.

5. Process

5.1 The steel shall be manufactured/produced by the following or as specified in the applicable material specification.
5.1.1 The steel shall be made by one of the following processes: electric-arc, electric-induction, or other suitable processes.
5.1.2 If a specific type of melting is required by the purchaser, it shall be so specified on the purchase order.

6. Heat Analysis

6.1 Methods and practices relating to chemical analysis shall be in accordance with Test Methods, Practices, and Terminology A 751.
6.2 An analysis of each heat shall be made by the steel producer to determine the percentages of the elements specified in the applicable material specification. This analysis shall be made from a test sample taken during the pouring of the melt, or from the in-process product later in the manufacturing flow.
6.2.1 The heat analysis shall conform to the chemical requirements for each of the specified elements for the grade ordered, as listed in the applicable product specification.
6.2.2 All commercial metals contain small amounts of elements other than those which are specified. It is neither practical nor necessary to specify limits for unspecified elements, whether intentionally added unspecified elements, residual elements, or trace elements, that can be present. The producer is permitted to analyze for unspecified elements and is permitted to report such analyses. The presence of an unspecified element and the reporting of an analysis for that element shall not be a basis for rejection, unless the presence of that element causes the loss of a property typically expected for that metal, for the type and quality ordered.
6.2.3 The purchaser is permitted to require in the purchase order a maximum limit for an individual element not specified

[4] Available from Automotive Industry Action Group (AIAG), 26200 Lahser Rd., Suite 200, Southfield, MI 48034.
[5] Available from American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036.
[6] Available from Standardization Documents Order Desk, Bldg. 4 Section D, 700 Robbins Ave., Philadelphia, PA 19111-5094, Attn: NPODS.

in the product specification. Such a requirement for an element not listed in the product specification, when acknowledged in the order acceptance, shall be treated as a specified element, with determination of chemical analysis and reporting of that analysis.

6.2.4 The purchaser is permitted to make the requirements for any element more stringent, that is, require higher minimums for elements having minimum requirements or ranges with minimum requirements, or requiring lower maximums for elements having specified maximums, or ranges with maximums. The purchaser is not permitted to make chemical requirements less stringent.

6.2.5 Analysis limits shall be established for specific elements rather than groups of elements, including but not limited to *all others*, *rare earths*, and *balance*, unless all elements in such a group are similar in technical effect and are associated in typical methods of chemical analysis.

6.3 The steel shall not contain an unspecified element for the ordered grade to the extent that the steel conforms to the requirements of another grade for which that element is a specified element having a required minimum content. For this requirement, a grade is defined as an alloy described individually and identified by its own UNS designation in a table of chemical requirements within this specification or any specification listed within the scope as being covered by the specification.

6.4 The producer is not permitted to certify that material is in compliance with an ASTM product specification when the purchase order has required that the material contain as a minimum or range an element that is neither a specified element nor an intentionally added unspecified element for the ordered grade in accordance with the definitions of Test Methods, Practices, and Terminology A 751.

7. Product Analysis

7.1 The purchaser is permitted to perform a product analysis (formerly check analysis) to verify the identity of the finished material representing each heat or lot. Such analysis shall be made by any of the commonly accepted methods that will positively identify the material.

7.2 The chemical composition determined in accordance with 7.1 shall conform to the limits of the material specification within the tolerances of Table A1.1, unless otherwise specified in the applicable material specification or the purchase order. The allowable variation of a particular element in a single sample for product analysis is permitted to be either above or below the specified range. However, percentages must exhibit the same tendencies in all samples; that is, the several determinations of any individual element in a heat shall not vary both above and below the specified range.

8. Material Test Report and Certification

8.1 A report of the results of all tests required by the product specification shall be supplied to the purchaser. This material test report shall reference the product specification designation and year date indicating that the material was manufactured, sampled, tested, and inspected in accordance with requirements of the product specification and has been found to meet those requirements. The material test report shall report the melting process when the purchase order requires either a specific type of melting or requires that the melting process used is to be reported.

8.1.1 The report shall indicate the type of steel. If certifying that the material conforms to the requirements for more than one type of steel, the manufacturer may indicate each type of steel on the report, or may issue a separate report for each type of steel.

8.2 A signature is not required on the report. However, the document shall clearly identify the organization submitting the report. Not withstanding the absence of a signature, the organization submitting the document is responsible for its content.

8.3 A material test report, certificate of inspection, or similar document printed from or used in electronic form from an electronic data interchange (EDI) transmission shall be regarded as having the same validity as a counterpart printed in the certifiers' facility. The content of the EDI transmitted document must meet the requirements of the invoked ASTM standard(s) and conform to any existing EDI agreement between the purchaser and the supplier. Notwithstanding the absence of a signature, the organization submitting the EDI transmission is responsible for the content of the report.

8.4 When finished material is supplied to a purchase order specifying the product specification, the organization supplying that material shall provide the purchaser with a copy of the original manufacturer's test report.

NOTE 2—Notwithstanding the absence of a signature, the organization submitting the report is responsible for the content of the report.

NOTE 3—The industry definition as invoked here is: EDI is the computer-to-computer exchange of business information in a standard format such as ANSI ASC X 12.

8.4.1 When the original manufacturer's test report was provided by EDI to the organization supplying the finished material to the purchaser, the organization supplying the finished material shall provide to the purchaser a printed form of the original test report or shall retransmit the test report by EDI to the purchaser. In either case, the test report shall be complete with the full identification of the original manufacturer and with all data provided on the test report of the original manufacturer.

9. Permitted Variations in Dimensions and Weight

9.1 Sheet, strip, and plate shall conform to the permitted variations in thickness, width, length and flatness, and other properties when specified, as listed in Annex A2 and Annex A3 for A 480 and A 480M respectively, for the ordered product form, or as agreed upon by seller and user and specified in the purchase order.

10. Workmanship

10.1 The material shall be of uniform quality consistent with good manufacturing and inspection practices. The steel shall have no imperfections of a nature or degree, for the type and quality ordered, that will adversely affect the stamping, forming, machining, or fabrication of finished parts.

10.2 *Sheet, Strip, and Plate*—For sheet, and strip with No. 1 finish and plate with hot-roll anneal or hot-roll anneal and pickle finish it is permitted to grind to remove surface

imperfections, provided such grinding does not reduce the thickness or width at any point beyond the permissible variations in dimensions. An iron free abrasive wheel shall be used for such grinding and shall be operated at a speed ample to ensure that defective areas are cleanly cut out.

11. Finish for Sheet

11.1 The types of finish available on sheet products are:

11.1.1 *No. 1 Finish*—Hot-rolled, annealed, and descaled.

11.1.2 *No. 2D Finish*—Cold-rolled, dull finish.

11.1.3 *No. 2B Finish*—Cold-rolled, bright finish.

11.1.3.1 *Bright Annealed Finish*—A bright cold-rolled finish retained by final annealing in a controlled atmosphere furnace.

11.1.4 *No. 3 Finish*—Intermediate polished finish, one or both sides.

11.1.5 *No. 4 Finish*—General purpose polished finish, one or both sides.

11.1.6 *No. 6 Finish*—Dull satin finish, Tampico brushed, one or both sides.

11.1.7 *No. 7 Finish*—High luster finish.

11.1.8 *No. 8 Finish*—Mirror finish.

11.1.9 *TR Finish*—Cold-worked to obtain specified properties.

NOTE 4—*Explanation of Sheet Finishes:*

No. 1—Commonly referred to as hot-rolled annealed and pickled or descaled. This is a dull, nonreflective finish.

No. 2D—A smooth, nonreflective cold-rolled annealed and pickled or descaled finish. This nondirectional finish is favorable for retention of lubricants in deep drawing applications.

No. 2B—A smooth, moderately reflective cold-rolled annealed and pickled or descaled finish typically produced by imparting a final light cold-rolled pass using polished rolls. This general-purpose finish is more readily polished than No. 1 or 2D finishes. Product with 2B finish is normally supplied in the annealed plus lightly cold-rolled condition unless a tensile-rolled product is specified.

Bright Annealed Finish —A smooth, bright, reflective finish typically produced by cold rolling followed by annealing in a protective atmosphere so as to prevent oxidation and scaling during annealing.

No. 3—A linearly textured finish that may be produced by either mechanical polishing or rolling. Average surface roughness (R_a) may generally be up to 40 micro-inches. A skilled operator can generally blend this finish. Surface roughness measurements differ with different instruments, laboratories, and operators. There may also be overlap in measurements of surface roughness for both No. 3 and No. 4 finishes.

No. 4—A linearly textured finish that may be produced by either mechanical polishing or rolling. Average surface roughness (R_a) may generally be up to 25 micro-inches. A skilled operator can generally blend this finish. Surface roughness measurements differ with different instruments, laboratories, and operators. There may also be overlap in measurements of surface roughness for both No. 3 and No. 4 finishes.

No. 6—This finish has a soft, satin appearance typically produced by tampico brushing a No. 4 finish.

No. 7—Has a high degree of reflectivity. It is produced by buffing a finely ground surface, but the grit lines are not removed. It is chiefly used for architectural or ornamental purposes.

No. 8—This is a highly reflective, smooth finish typically produced by polishing with successively finer grit abrasives, then buffing. Typically, very faint buff of polish lines may still be visible on the final product. Blending after part assembly may be done with buffing.

TR Finish—The finish resulting from the cold-rolling of an annealed and descaled or bright annealed product to obtain mechanical properties higher than that of the annealed condition. Appearance will vary depending upon the starting finish, amount of cold work, and the alloy.

Architectural Finishes—Sometimes described as a No. 5 finish, these are a separate category and may be negotiated between buyer and seller, as there are many techniques and finish variations available throughout the world.

11.1.10 Architectural finish, No. 5, or other proprietary names are special finishes.

11.1.11 Note 4 is not meant to be restrictive or to be used as a basis for rejection but is intended to give general guidelines. Various production methods may be used to obtain these finishes.

11.1.12 Sheets can be produced with one or two sides polished. When polished on one side only, it is permitted to rough grind the other side in order to obtain the necessary flatness.

12. Finish for Strip

12.1 The various types of finish procurable on cold-rolled strip products are:

12.1.1 *No. 1 Finish*—Cold-rolled to specified thickness, annealed, and descaled.

12.1.2 *No. 2 Finish*—Same as No. 1 Finish, followed by a final light cold-roll pass, generally on highly polished rolls.

12.1.3 *Bright Annealed Finish*—A bright cold-rolled finish retained by final annealing in a controlled atmosphere furnace.

12.1.4 *TR Finish*—Cold-worked to obtain specified properties.

12.1.5 *Polished Finish*—Stainless steel strip is also available in polished finishes such as No. 3 and No. 4, which are explained in Note 4.

NOTE 5—*Explanation of Strip Finishes:*

No. 1—Appearance of this finish varies from dull gray matte finish to a fairly reflective surface, depending largely upon composition. This finish is used for severely drawn or formed parts, as well as for applications where the brighter No. 2 Finish is not required, such as parts for heat resistance.

No. 2—This finish has a smoother and more reflective surface, the appearance of which varies with composition. This is a general purpose finish, widely used for household and automotive trim, tableware, utensils, trays, etc.

Bright Annealed Finish—See Note 4.

TR Finish—See Note 4.

13. Finish for Plates

13.1 The types of finish available on plates are:

13.1.1 *Hot-Rolled or Cold-Rolled, and Annealed or Heat Treated*—Scale not removed, an intermediate finish. Use of plates in this condition is generally confined to heat-resisting applications. Scale impairs corrosion resistance.

13.1.2 *Hot-Rolled or Cold-Rolled, and Annealed or Heat Treated, and Blast Cleaned or Pickled*—Condition and finish commonly preferred for corrosion-resisting and most heat-resisting applications, essentially a No. 1 Finish.

13.1.3 *Hot-Rolled or Cold-Rolled, and Annealed or Heat Treated, and Surface Cleaned and Polished*—Polish finish is generally No. 4 Finish.

13.1.4 *Hot-Rolled or Cold-Rolled, and Annealed or Heat Treated, and Descaled, and Temper Passed*—Smoother finish for specialized applications.

13.1.5 *Hot-Rolled or Cold-Rolled, and Annealed or Heat Treated, and Descaled; and Cold-Rolled, and Annealed or Heat Treated, and Descaled, and Optionally Temper Passed*—Smooth finish with greater freedom from surface imperfections than in 13.1.4.

14. Edges for Cold-Rolled Strip

14.1 The types of edges available on strip products are:

14.1.1 *No. 1 Edge*—A rolled edge, either round or square as specified.

14.1.2 *No. 3 Edge*—An edge produced by slitting.

14.1.3 *No. 5 Edge*—An approximately square edge produced by rolling or filing after slitting.

15. Heat Treatment

15.1 The heat treatments shown in this section are to be followed unless otherwise specified in the applicable material specification. Heat treatment thermal cycles shall be separate from other thermal processing cycles; for example, in-process thermal cycles are not permitted as a substitute for the separate annealing cycle.

15.2 *Austenitic Types:*

15.2.1 The material shall be solution annealed to meet the mechanical property requirements of the applicable material specification unless otherwise stated in the material specification.

15.2.2 Except as indicated in Table A1.2, Series 300, XM-15, N08800, S30415, S30815, S31725, S31726, and S32615 austenitic chromium-nickel steels, when specified on the purchase order, shall be capable of meeting the test for resistance to intergranular corrosion specified in 18.2.

15.2.3 For grades stabilized with titanium or columbium, refer to Note 6.

NOTE 6—Solution-annealing temperatures above 1950°F [1066°C] can impair the resistance to intergranular corrosion after subsequent exposure to sensitizing conditions in the stabilized grades, Types 309Cb, 309HCb, 310Cb, 310HCb, 316Ti, 316Cb, 321, 321H, 347, 347H, 348, 348H, and S35135. When intergranular corrosion is of concern, the purchaser should specify the corrosion test of 18.2 (to be conducted on sensitized specimens). The manufacturer is permitted, if necessary, use a lower temperature resolution anneal or a stabilization anneal after a high temperature solution anneal in order to meet corrosion test requirements. Consideration should be given to the corrosive media before using a stabilization anneal at less than 1800°F [982°C], as such treatment is not equally effective for all media.

15.2.4 For the stabilized H types, it is noted that the heat treatment requirements shown in Table A1.2 differ as a function of whether the material was cold worked or hot finished.

15.2.5 The chromium-manganese-nickel types (201, 202, S20103, S20400, S20153, S21800, XM-17, XM-18, XM-19, XM-29, and XM-31) shall be solution annealed to meet the mechanical property requirements of the applicable material specification and, to exhibit adequate resistance to intergranular corrosion (see 18.2). For S20161, the heat treatment is specified in Table A1.2.

15.2.5.1 Note that some of these types contain high carbon content that can adversely affect resistance to intergranular corrosion.

15.3 *Duplex Types*—The duplex types shall be solution annealed in accordance with Table A1.2.

15.4 *Martensitic and Ferritic Types:*

15.4.1 The chromium steels (S32803, 400 Series, S40945, S41045, S41050, S41500, S43932, S44400, S44635, S44660, S44700, S44735, S44800, XM-27, and XM-33) shall be heat treated in such a manner as to satisfy all the requirements for mechanical and bending properties specified in the applicable material specification and (except for 400 Series, S41050, and S41500) to provide for adequate resistance to intergranular attack.

15.4.2 For S41500, heat to 1750°F [955°C] minimum, air cool to 200°F [93°C] or lower prior to any optional intermediate temper and prior to final temper. The final temper shall be between 1050°F [566°C] and 1150°F [621°C].

16. Number of Tests

16.1 Unless otherwise specified by the applicable material specification or by agreement between the seller and the purchaser to perform a greater number of tests, the following number of tests are to be performed.

16.1.1 In the case of plate, sheet, and strip produced in coil form, two or more hardness tests (one from each end of the coil); one bend test, when required; one permeability test, when required; and one or more tension tests shall be made on specimens taken from each coil. If the hardness difference between the two ends of the coil exceeds 5 HRB, or equivalent, or if the material is temper rolled, tensile properties must be determined on both coil ends.

16.1.2 In the case of plate, sheet, or strip produced in cut lengths, one tension test; two tension tests if the material is temper rolled (one tension test for single piece lots); one bend test when required, and one or more hardness tests shall be made on each 100 or less pieces of the same heat and nominal thickness rolled separately or continuously and heat treated within the same operating period, either as a lot or continuously.

NOTE 7—The term continuously, as applied to heat treatment, is meant to describe a heat-treating operation in which one cut length follows another through the furnace. Interspersement of different melts is permissible if they are of approximately the same nominal thickness and are heat treated in the same operating period and under the same conditions (time and temperature).

16.1.3 One intergranular corrosion test, when required, shall be selected from each heat and thickness subjected to the same heat treatment practice. It is permitted to obtain such specimens from specimens selected for mechanical testing.

17. Test Specimens

17.1 *Tension Test:*

17.1.1 Tension test specimens shall be taken from finished material and shall be selected in either or both longitudinal and transverse direction. The tension test specimen shall conform to the appropriate sections of Test Methods and Definitions A 370, unless otherwise specified in the applicable material specification or agreed upon by the seller and the purchaser.

17.1.2 The testing speed between the yield strength and the fracture of the specimen, shall be conducted at a constant strain rate between ⅛ in. [3.18 mm] and ½ in. [12.70 mm]

inclusive, per inch [25.40 mm] of gage length per minute, or at a crosshead speed that will give a strain rate within this range. For the purposes of this specification, the rate of strain shall be determined by a strain-rate pacer, indicator, or controller, or by dividing the unit elongation by the elapsed time from yield strength to fracture.

17.2 *Hardness Test*—It is permitted to perform hardness tests on the grip ends of the tension specimens before they are subjected to the tension test.

17.3 *Bend Test:*

17.3.1 Bend test specimens (when required) shall be taken from finished material and shall be selected in the transverse direction or as indicated in the applicable material specification or as agreed upon by the seller and the purchaser. In the case of transverse bend test specimens, the axis of bend shall be parallel to the direction of rolling.

17.3.2 Bend test specimens from sheet and strip product shall be the full thickness of the material and approximately 1 in. [25.4 mm] in width. It is permitted to round the edges of the test specimen to a radius equal to one half the specimen thickness.

17.3.3 The width of strip for which bend tests can be made is subject to practical limitations on the length of the bend test specimen. For narrow strip, the following widths can be tested:

Strip thickness, in. [mm]	Minimum Strip Width and Minimum Specimen Length for Bend Tests, in. [mm]
0.100 [2.5] and under	½ [12.7]
Over 0.100 [2.5] to 0.140 [3.5], excl.	1 [25.4]
0.140 [3.5] and over	1½ [38.1]

Bend test specimens shall be of any suitable length over the specified minimum length.

17.3.4 Bend test specimens taken from plates shall be in full thickness of the material up to and including ½ in. [12.7 mm] in thickness, of suitable length, and between 1 and 2 in [25.4 and 50.8 mm] in width. It is permitted to remove the sheared edges to a depth of at least ⅛ in. [3.2 mm] and it is permitted to smooth the sides with a file. It is permitted to break the corners of the cross section of the specimen with a file, but no appreciable rounding of the corners is permitted.

17.3.5 In the case of plates over ½ in. [12.7 mm] in thickness, it is permitted to use bend test specimens, machined to 1 in. [25.4 mm] nominal width by ½ in. [12.7 mm] nominal thickness and at least 6 in. [152.4 mm] in length. One surface, to be the outside surface in bending, shall be the original surface of the plate; however, surface preparation by light grinding is permitted. It is permitted to round the edges to a 1/16 in. [1.6 mm] radius. When agreed by the seller and the purchaser, it is permitted to modify the cross section to ½ in. [12.7 mm] nominal square.

17.3.6 In the case of plates over 1 in. [25.4 mm] in thickness, bend tests must be agreed upon between the seller and the purchaser.

17.3.7 The bend test specimen shall withstand cold bending through the angle specified in the applicable material specification without cracking on the outside of the bent portion.

17.4 The bend shall be made over a diameter equal to the number of thicknesses of flat stock shown in the applicable material specification or over a single piece of flat stock equal to the number of thicknesses shown in the applicable material specification; or as follows:

17.4.1 Material up to and including ⅜ in. [9.5 mm] in thickness shall be bent over a piece (or pieces) of flat stock that has the same nominal thickness of the material being tested (1T), allowing the test material to form its natural curvature.

17.4.2 Material over ⅜ in. [9.5 mm] and up to and including 1 in [25.4 mm] in thickness shall be bent over a piece (or pieces) of flat stock equalling two times the thickness of the material being tested (2T), allowing the test material to form its natural curvature.

18. Special Tests

18.1 If other tests are required, the methods and acceptance criteria shall be agreed upon between the seller and the purchaser and specified on the purchase order.

18.2 *Resistance to Intergranular Corrosion:*

18.2.1 The intergranular corrosion test, Practice E of Practices A 262, is not required unless it is specified on the purchase order. All austenitic chromium-nickel types except the H types are expected to be capable of passing this test. However, it is not necessary to actually run the test unless it is specified on the purchase order. Note that Practices A 262 requires the test to be performed on sensitized specimens in the low-carbon and stabilized types and on specimens representative of the as-shipped condition for other types. In the case of low-carbon types containing 3 % or more molybdenum in their specified composition, the applicability of the sensitizing treatment prior to testing shall be a matter for negotiation between the seller and the purchaser. When specified, all flat rolled products of the chromium-nickel series (300 series) in thickness up to and including 2 in. [50.8 mm] nominal size shall be capable of passing the intergranular corrosion test in the as shipped condition. In the case of heavier plates of types other than 304L, 304LN, 309Cb, 310Cb, 316Cb, 316L, 316LN, 316Ti, 317L, 321, 347, 348, S31725, and S31726, the applicability of this test shall be a matter for negotiation between the seller and the purchaser.

18.2.2 The H types are not normally subject to intergranular corrosion tests. However, it is permitted to specify Practice E of Practices A 262 for Type 321H when intergranular corrosion is of concern. In this case, the purchaser shall inform the seller and agree upon the requirements and these requirements shall be so stated on the purchase order.

18.2.3 Austenitic chromium-manganese-nickel types (201, 202, XM-17, XM-18, XM-19, XM-29, XM-31, S20400, and S21800) are to be heat treated for intergranular corrosion resistance. When intergranular corrosion tests are required, they shall be as agreed upon between the seller and the purchaser.

18.2.4 N08800 shall be heat treated for intergranular corrosion resistance. When intergranular corrosion tests are required, they shall be as agreed upon between the seller and purchaser.

18.2.5 Corrosion tests are not normally required for the 400 series types. Lower-carbon corrosion-resistant types (S44400, S44635, S44660, S44700, S44800, S44735, XM-27, and XM-33) are heat treated for resistance to corrosion. For S44400,

S44635, S44660, S44700, S44800, S44735, XM-27, and XM-33, intergranular corrosion testing of Practices A 763, Practice X, Y, or Z shall be specified as agreed upon between the seller and the purchaser.

18.3 *Detrimental Intermetallic Phases in Duplex Stainless Steels*—The tests for detrimental intermetallic phases in wrought duplex stainless steels, Methods A, B, or C of Test Methods A 923, are not required unless it is specified on the purchase order. All duplex (austenitic-ferritic) types that are listed in Test Methods A 923 are expected to be capable of passing these tests. However, it is not necessary to actually run the tests unless specified on the purchase order. The applicability of these tests to duplex stainless steels not listed in Test Methods A 923 shall be a matter for negotiation between the seller and the purchaser.

19. Test Methods

19.1 The properties enumerated in applicable specifications shall be determined in accordance with the following ASTM standards.

19.1.1 *Tension Tests*—Test Methods and Definitions A 370.

19.1.2 *Brinell Tests*—Test Methods and Definitions A 370.

19.1.3 *Rockwell Hardness*—Test Methods and Definitions A 370.

19.1.4 *Hardness Equivalents*—Tables E 140.

19.1.5 *Intergranular Corrosion (when specified)*—Practices A 262, Practices A 763.

19.1.6 *Permeability Test (when required)*—Test Methods A 342/A 342M.

19.1.7 *Charpy Impact Testing (when required)*—Test Methods and Definitions A 370.

19.1.8 *Intermetallic Phases (when specified)*—Test Methods A 923.

20. Retests and Retreatment

20.1 Retests are permitted in accordance with the provisions of Test Methods and Definitions A 370.

20.2 If any test specimen shows defective machining or develops flaws, it is permitted to discard the flawed specimen and substitute another specimen.

20.2.1 If the percentage of elongation of any tension specimen is less than that specified and any part of the fracture is more than ¾ in. [19.1 mm] from the center of the gage length of the 2 in. [50.8 mm] specimen or is outside the middle half of the gage length of an 8-in. [203.2-mm] specimen, as indicated by scribe marks placed on the specimen before testing, a retest shall be allowed.

20.3 If a bend test specimen fails, due to conditions of bending more severe than required by the specification, a retest shall be permitted, either on a duplicate specimen or on a remaining portion of the failed specimen.

20.4 If the results of any test lot are not in conformance with the requirements of the applicable material specification, the producer is permitted the option of retreating such lots. The material shall be accepted if the results of retests on retreated material are within the specified requirements.

20.5 If any specimens selected to represent any heat fail to meet any of the test requirements as specified in the applicable material specification, it is permitted to reheat treat the material represented and resubmit it for testing.

20.6 If the product analysis fails to conform to the specified limits, analysis shall be made on a new sample. The results of this retest shall be within the specified requirements.

21. Repair of Plate by Welding

21.1 Repair of surface defects of plate, by welding, is permitted unless prohibited by other specifications or purchase order requirements.

21.2 Defect depth shall not exceed ⅓ of the nominal thickness, and the total area shall not exceed 1 % of the plate surface area, unless prior approval from the purchaser is obtained.

21.3 Unacceptable imperfections shall be suitably prepared for welding by grinding or machining. Open clean defects, such as pits or impressions, will not necessarily require preparation.

21.4 The welding procedure and the welders or welding operators shall be qualified in accordance with Section IX of the ASME Code.[2]

21.5 The welding consumables shall be suitable with the plate.

21.6 After repair welding, the welded area shall be ground smooth and blended uniformly to the surrounding surface.

22. Inspection

22.1 Inspection of the material by the purchaser's representative at the producing plant shall be made as agreed upon between the purchaser and the seller as part of the purchase order.

22.2 Unless otherwise specified in the contract or purchase order: (*1*) the seller is responsible for the performance of all the inspection and test requirements in this specification, (*2*) the seller is permitted to use own or other suitable facilities for the performance of the inspection and testing, and (*3*) the purchaser shall have the right to perform any of the inspection and tests set forth in this specification. The manufacturer shall afford the purchaser's inspector all reasonable facilities necessary to satisfy the inspector that the material is being furnished in accordance with the specification. Inspection by the purchaser shall not interfere unnecessarily with the manufacturer.

23. Rejection

23.1 Unless otherwise specified, any rejection based on tests made in accordance with this specification shall be reported to the seller within 60 working days from the receipt of the material by the purchaser.

23.2 Material that shows injurious imperfections as described in Section 10 subsequent to its acceptance at the purchaser's works will be rejected and the seller shall be notified.

24. Rehearing

24.1 Samples tested in accordance with this specification that represent rejected material shall be retained for three weeks from the date of the notification to the seller of the

rejection. In case of dissatisfaction with the results of the test, the seller is permitted to make claim for a rehearing within that time.

25. Packaging, Marking, and Loading

25.1 *For Commercial Procurement*:

25.1.1 *Marking*—Unless otherwise specified in the applicable material specification or the purchase order, marking shall be conducted as follows:

25.1.1.1 Sheet, strip, and plate shall be marked on one face, in the location indicated below with the specification designation number, type of steel (type or UNS designation), material identification number, and the name or mark of the manufacturer. For sheet, strip, and plate whose length and width dimensions are both less than 24 in., each piece shall be marked with the type of steel and material identification number. The specification and designation number, and name or mark of the manufacturer shall be marked on the piece(s) or attached to the item or bundle. The characters shall be of such size as to be clearly legible. The marking shall be sufficiently stable to withstand normal handling. Unless otherwise specified by the purchaser, the marking, at the producers option, is permitted to be done with *(a)* marking fluid (if a specific maximum impurity limit of designated elements in the marking fluid is required by the purchaser, it shall be so stated on the purchase order), *(b)* low-stress blunt-nosed continuous or low-stress blunt-nosed-interrupted-dot die stamp, *(c)* a vibratory tool with a minimum tip radius of 0.005 in. [0.1 mm], or *(d)* electrochemical etching.

25.1.1.2 Flat sheet, strip in cut lengths, and plate shall be marked in two places near the ends or shall be continuously line marked along one edge. For flat sheet, strip in cut lengths, and plate whose length and width dimensions are both less than 48 in., it is permitted to mark such pieces in only one place.

25.1.1.3 Sheet, strip, and plate in coil form shall be marked near the outside end of the coil. The inside of the coil shall also be marked or shall have a tag or label attached and marked with the information of 25.1.1.1.

25.1.1.4 Material less than ¼ in. [6.4 mm] in thickness shall not be marked with die stamps.

25.1.1.5 The manufacturer's test identification number shall be legibly stamped on each test specimen, if to be shipped to the customer.

25.1.1.6 Material that conforms completely with the requirements of two types of steel within the ordering specification is permitted to be marked as both types of steel provided that the manufacturer is certifying the material as meeting the requirements of each of the types of steel. Such marking, if used, shall be part of the same marking as used for a single type of steel, or shall be a separate but similar marking immediately adjacent to the marking used for a single type of steel.

25.1.1.7 The AIAG primary metals identification tag (AIAG B-5) is permitted to be used as an auxiliary method of identification in cases where a bar-coded identification tag is desired. Use of this method shall be by agreement between purchaser and supplier.

25.1.2 *Packaging and Loading*—Unless otherwise specified in the applicable material specification or the purchase order, packaging and loading shall be in accordance with the procedures recommended by Practices A 700.

25.2 *For U.S. Government Procurement*:

25.2.1 When specified in the contract or order, and for direct procurement by or direct shipment to the government, marking for shipment shall be in accordance with Fed. Std. No. 123 for civil agencies and MIL-STD-129 for military agencies.

25.2.2 When specified in the contract or order, material shall be preserved, packaged, and packed in accordance with the requirements of MIL-STD-163. The applicable levels shall be as specified in the contract or order.

26. Keywords

26.1 austenitic stainless steel; duplex stainless steel; ferritic stainless steel; martensitic stainless steel; stainless steel; stainless steel plate; stainless steel sheet; stainless steel strip

ANNEXES

(Mandatory Information)

A1. PRODUCT ANALYSIS TOLERANCES AND HEAT TREATMENT REQUIREMENTS

A1.1 Listed in Annex A1 are tables showing the permitted variations of composition for product analysis relative to specified chemical requirements (Table A1.1) and the heat treatment requirements for types of stainless steel covered by product specifications that reference Specification A 480/A 480M (Table A1.2).

TABLE A1.1 Chemical Requirements (Product Analysis Tolerances)[A]

Elements	Limit or Maximum of Specified Range, %	Tolerance Over the Maximum Limit or Under the Minimum Limit	Elements	Limit or Maximum of Specified Range, %	Tolerance Over the Maximum Limit or Under the Minimum Limit
Carbon	to 0.010, incl	0.002	Titanium	to 1.00, incl	0.05
	over 0.010 to 0.030, incl	0.005		over 1.00 to 3.00, incl	0.07
	over 0.030 to 0.20, incl	0.01			
	over 0.20 to 0.60, incl	0.02	Cobalt	over 0.05 to 0.50, incl	0.01[B]
	over 0.60 to 1.20, incl	0.03		over 0.50 to 2.00, incl	0.02
				over 2.00 to 5.00, incl	0.05
Manganese	to 1.00, incl	0.03			
	over 1.00 to 3.00, incl	0.04	Columbium plus tantalum	to 1.50, incl	0.05
	over 3.00 to 6.00, incl	0.05			
	over 6.00 to 10.00, incl	0.06			
	over 10.00 to 15.00, incl	0.10			
	over 15.00 to 20.00, incl	0.15	Tantalum	to 0.10, incl	0.02
Phosphorus	to 0.040, incl	0.005	Copper	to 0.50, incl	0.03
	over 0.040 to 0.20, incl	0.010		over 0.50 to 1.00, incl	0.05
				over 1.00 to 3.00, incl	0.10
Sulfur	to 0.040, incl	0.005		over 3.00 to 5.00, incl	0.15
	over 0.040 to 0.20, incl	0.010		over 5.00 to 10.00, incl	0.20
	over 0.20 to 0.50, incl	0.020			
			Aluminum	to 0.15, incl	−0.005, +0.01
Silicon	to 1.00, incl	0.05		over 0.15 to 0.50, incl	0.05
	over 1.00 to 3.00, incl	0.10		over 0.50 to 2.00, incl	0.10
	over 3.00 to 6.00, incl	0.15			
Chromium	over 4.00 to 10.00, incl	0.10			
	over 10.00 to 15.00, incl	0.15	Nitrogen	to 0.02, incl	0.005
	over 15.00 to 20.00, incl	0.20		over 0.02 to 0.19, incl	0.01
	over 20.00 to 30.00, incl	0.25		over 0.19 to 0.25, incl	0.02
				over 0.25 to 0.35, incl	0.03
Nickel	to 1.00, incl	0.03		over 0.35 to 0.45, incl	0.04
	over 1.00 to 5.00, incl	0.07		over 0.45 to 0.55, incl	0.05
	over 5.00 to 10.00, incl	0.10	Tungsten	to 1.00, incl	0.03
	over 10.00 to 20.00, incl	0.15		over 1.00 to 2.00, incl	0.05
	over 20.00 to 30.00, incl	0.20			
			Vanadium	to 0.50, incl	0.03
Molybdenum	over 0.20 to 0.60, incl	0.03		over 0.50 to 1.50, incl	0.05
	over 0.60 to 2.00, incl	0.05			
	over 2.00 to 8.00, incl	0.10	Selenium	all	0.03

[A] This table does not apply to heat analysis.
[B] Product analysis limits for cobalt under 0.05 % have not been established, and the manufacturer should be consulted for those limits.

TABLE A1.2 Heat Treatment Requirements

Designation/Type	Temperature[A]	Cooling/Testing Requirements
Austenitic (Chromium-Nickel) (Chromium-Nickel-Manganese)		
All Cr-Ni steels except as listed below	1900°F [1040°C]	[B]
302, S30215, S30452, S30615, 308, 309, 309Cb, 310, 310Cb, S32615, S33228, S38100	1900°F [1040°C]	[C]
304H, 309H, 310H, 316H 309HCb, 310HCb, 321H, 347H, 348H	1900°F [1040°C]	[C]
Cold Worked	2000°F [1095°C]	[C]
Hot Finished	1925°F [1050°C]	[C]
S31060	1975° to 2160°F [1080° to 1180°C]	[C]
N08811	2100°F [1150°C]	[C]
N08020	1700° to 1850°F [925° to 1010°C]	[C]
N08367	2025°F [1105°C]	[C]
N08810	2050°F [1120°C]	[C]
N08904	2000°F [1095°C]	[C]
N08926	2010°F [1100°C]	[C]
S31277	2050°F [1120°C]	[C]
S20161	1900° to 2000°F [1040° to 1095°C]	[C]
S30600, S30601	2010° to 2140°F [1100° to 1170°C]	[C]
S31254, S31266, S32050, S32654	2100°F [1150°C]	[C]
S32053	1975 to 2155°F [1080 to 1180°C]	[C]
S31727	1975 to 2155°F [1080 to 1180°C]	[C]
S33228	2050 to 2160°F [1120 to 1180°C]	[C]
S34565	2050° to 2140°F [1120° to 1170°C]	[C]
S35315	2010°F [1100°C]	[C]
Duplex (Austenitic-Ferritic)		
S31200, S31803, S32001, S32550	1900°F [1040°C]	[C]
S31260	1870° to 2010°F [1020° to 1100°C]	[C]
S32003	1850°F [1010°C]	[C]
S32101	1870°F [1020°C]	[C]
S32205	1900°F [1040°C]	[D]
S32304	1800°F [980°C]	[C]
S32506	1870 to 2050°F [1020 to 1120°C]	[C]
S32520	1975 to 2050°F [1080 to 1120°C]	[C]
S32750	1880° to 2060°F [1025° to 1125°C]	[C]
S32760	2010°F [1100°C]	[C]
S32900	1750° ± 25°F [955° ± 15°C]	[C]
S32906	1900° to 1980°F [1040° to 1080°C]	[C]
S32950	1850° ± 25°F [1010° ± 15°C]	[C]
S39274	1925 to 2100°F [1050 to 1150°C]	[C]

[A] Minimum, unless otherwise indicated.
[B] Quenched in water or rapidly cooled by other means at a rate sufficient to prevent reprecipitation of carbides, as demonstrable by the capability of passing the test for resistance to intergranular corrosion specified in 18.2.
[C] Quenched in water or rapidly cooled by other means.
[D] Quenched in water, except that coiled product heat treated in a continuous annealing line shall be water quenched or rapidly cooled by other means.

A2. PERMITTED VARIATIONS IN DIMENSIONS, ETC.—INCH-POUND UNITS

A2.1 Listed in Annex A2 are tables showing the permissible variations in dimensions expressed in inch-pound units of measurement. These requirements, including the SI units shown in brackets within Annex A2, shall apply to A 480, but shall not apply to A 480M. Requirements for A 480M are given in Annex A3.

A2.1.1 The dimensional tolerances are grouped by production method (hot rolling or cold rolling, with or without coiling), product width (narrow (<24 in. [610 mm]) or wide (≥24 in. [610 mm])), and by product dimension addressed.

A2.2 *Cold-Rolled Narrow (<24 in. [610 mm] width) Coil-Processed Product*—For thickness, width, length, and flatness tolerance tables, refer to Tables A2.1-A2.4.

A2.3 *Cold-Rolled Wide (≥24 in. [610 mm] width) Coil-Processed Product*— For thickness, width, length, and flatness tolerance tables, refer to Tables A2.5-A2.8.

A2.4 *Hot-Rolled Narrow (<24 in. [610 mm] width) Coil-Processed Product*—For thickness, width, length, and flatness tolerance tables, refer to Tables A2.9-A2.12.

A2.5 *Hot-Rolled Wide (≥24 in. [610 mm] width) Coil-Processed Product*— For thickness, width, length, and flatness tolerance tables, refer to Tables A2.13-A2.16.

A2.6 *Hot-Rolled Product Processed Without Coiling*—For thickness, width, length, and flatness tolerance tables, refer to Tables A2.17-A2.20.

TABLE A2.1 Permitted Variations in Thickness for Cold-Rolled, Narrow, Coil-Processed Product as Coils and Cut Lengths

NOTE 1—Thickness measurements are taken at least ⅜ in. [9.52 mm] in from the edge of the product, except on widths less than 1 in. [25.4 mm] the measurements should be taken at least ⅛ in. [3.18 mm] from the product edge.

NOTE 2—The tolerances in this table include crown tolerances.

Specified Thickness, in. [mm]	Thickness Tolerances, for the Thickness and Widths Given, Over and Under, in. [mm]		
	Width (w), in. [mm]		
	³⁄₁₆ [4.76] to 6 [152], incl $w \le 6$ [152]	Over 6 [152] to 12 [305], incl 6 [152] < $w \le 12$ [305]	Over 12 [305] to 24 [610], excl 12 [305] < $w \le 24$ [610]
	Thickness Tolerances[A]		
0.002 [0.05] to 0.005 [0.13], excl	10 %	10 %	10 %
0.005 [0.13] to 0.010 [0.25] , incl.	0.0006 [0.015]	0.0008 [0.020]	0.001 [0.025]
Over 0.010 [0.25] to 0.012 [0.30], incl	0.001 [0.025]	0.001 [0.025]	0.001 [0.025]
Over 0.012 [0.30] to 0.015 [0.40], incl	0.001 [0.025]	0.0015 [0.04]	0.0015 [0.04]
Over 0.015 [0.40] to 0.020 [0.50], incl	0.001 [0.025]	0.0015 [0.04]	0.0015 [0.04]
Over 0.020 [0.50] to 0.029 [0.74], incl	0.0015 [0.04]	0.0015 [0.04]	0.002 [0.050]
Over 0.029 [0.74] to 0.035 [0.89], incl	0.0015 [0.04]	0.002 [0.050]	0.002 [0.050]
Over 0.035 [0.89] to 0.050 [1.27], incl	0.0025 [0.060]	0.003 [0.070]	0.003 [0.070]
Over 0.050 [1.27] to 0.069 [1.75], incl	0.003 [0.070]	0.003 [0.070]	0.003 [0.070]
Over 0.069 [1.75] to 0.100 [2.54], incl	0.003 [0.070]	0.003 [0.070]	0.004 [0.10]
Over 0.100 [2.54] to 0.125 [2.98], incl	0.004 [0.10]	0.004 [0.10]	0.005 [0.12]
Over 0.125 [2.98] to 0.161 [4.09], incl	0.005 [0.12]	0.005 [0.12]	0.005 [0.12]
Over 0.161 [4.09] to under ³⁄₁₆ [4.76]	0.005 [0.12]	0.005 [0.12]	0.006 [0.15]

[A] Thickness tolerances given in in. [mm] unless otherwise indicated.

TABLE A2.2 Permitted Variations in Width for Cold-Rolled, Narrow, Coil-Processed Product as Coils and Cut Lengths for Edge No. 3[A]

Specified Thickness[B], in. [mm]	Width Tolerance, Over and Under, for Thickness and Width Given, in. [mm]			
	$w \le 1.60$ [40]	1.60 [40] < $w \le 6$ [150]	6 [150] < $w \le 12$ [305]	12 [300] < $w \le 24$ [610]
0.010 [0.25]	0.003 [0.085]	0.004 [0.10]	0.005 [0.125]	0.020 [0.50]
0.020 [0.50]	0.005 [0.125]	0.005 [0.125]	0.010 [0.25]	0.020 [0.50]
0.040 [1.00]	0.005 [0.125]	0.005 [0.125]	0.010 [0.25]	0.020 [0.50]
0.060 [1.50]	0.005 [0.125]	0.006 [0.15]	0.010 [0.25]	0.020 [0.50]
0.100 [2.50]	. . .	0.010 [0.25]	0.016 [0.40]	0.020 [0.50]
0.120 [3.00]	. . .	0.010 [0.25]	0.016 [0.40]	0.024 [0.60]
0.160 [4.00]	. . .	0.016 [0.40]	0.016 [0.40]	0.024 [0.60]
0.200 [4.99]	. . .	0.030 [0.80]	0.030 [0.80]	0.030 [0.80]

[A] For tolerances applicable to narrow product with Edge No. 1 or No. 5, see Table A2.31.

[B] For specified thickness other than those shown, the tolerances for the next higher thickness shall apply.

TABLE A2.3 Permitted Variations in Length for Cold-Rolled, Narrow, Coil-Processed Product as Cut Lengths

Specified Length, ft [mm]	Tolerances, in. [mm]
≤6 [1830]	+⅛ [3], –0
>6 [1830] to ≤12 [3660]	+0.2 [5], –0
>12 [3069] to ≤20 [6096]	+0.3 [8], –0

TABLE A2.4 Permitted Variations in Flatness of Cold-Rolled, Narrow, Coil-Processed Product as Cut Lengths

Tolerances for variations of flatness cold-rolled products, narrow, coil-processed product as cut lengths shall be identical to the tolerances for cold-rolled, wide, coil-processed product as listed in Table A2.8 unless otherwise agreed upon by seller and purchaser and specified in the purchase order.

A2.7 *Cold-Rolled Product Processed Without Coiling*—For thickness, width, length, and flatness tolerance tables, refer to Table A2.21.

A2.8 *Tolerances for other dimensional characteristics*—For other tolerance tables, refer to Tables A2.22-A2.30.

TABLE A2.5 Permitted Variations in Thickness of Cold-Rolled, Wide, Coil-Processed Product as Coil and Cut Lengths

Specified Thickness[A,B], in. [mm]	Permitted Variation, Over and Under, in [mm], for specified width (w), w in in.		
	$w \le 40$ [1000]	40 [1000] $< w \le$ 50 [1300]	50 [1300] $< w \le$ 84 [2100]
0.012 [0.30]	0.001 [0.030]	. . .	. . .
0.016 [0.40]	0.0015 [0.04]	0.0015 [0.04]	. . .
0.020 [0.50]	0.0015 [0.04]	0.0015 [0.04]	
0.024 [0.60]	0.002 [0.05]	0.002 [0.05]	. . .
0.032 [0.80]	0.002 [0.05]	0.002 [0.05]	. . .
0.040 [1.00]	0.0025 [0.06]	0.0025 [0.06]	0.003 [0.08]
0.047 [1.20]	0.003 [0.08]	0.003 [0.08]	0.003 [0.08]
0.059 [1.50]	0.003 [0.08]	0.003 [0.08]	0.004 [0.10]
0.079 [2.00]	0.004 [0.10]	0.004 [0.10]	0.0045 [0.11]
0.098 [2.50]	0.004 [0.10]	0.004 [0.10]	0.005 [0.13]
0.118 [3.00]	0.005 [0.13]	0.005 [0.13]	0.006 [0.15]
0.157 [4.00]	0.007 [0.17]	0.007 [0.17]	0.007 [0.17]
0.197 [5.00]	0.007 [0.17]	0.007 [0.17]	0.0075 [0.19]
0.236 [6.00]	0.007 [0.17]	0.008 [0.20]	0.009 [0.23]
0.3125 [8.00]	0.007 [0.17]	0.009 [0.23]	0.010 [0.25]

[A] Thickness measurements are taken at least ⅜ in. [9.52 mm] from the edge of the sheet.
[B] For specified thicknesses other than those shown, the tolerances for the next higher thickness shall apply.

TABLE A2.6 Permissible Variations in Width for Cold-Rolled Wide, Coil-Processed Product as Cut Lengths (Not Resquared) and Coil

Specified Thickness, in. [mm][A]	Permitted Variation in Width (w), in. [mm], for Specified Width (w), in. [mm]				
	$w \le 6$ [150]	6 [125] $< w \le 12$ [300]	12 [300] $< w \le 24$ [600]	24 [600] $< w <$ 48 [1200]	48 [1000] $\ge w$
0.040 [1.00]	+0.02 [0.5], –0	+0.02 [0.5], –0	+0.03 [0.7], –0	+1/16 [1.6], –0	+⅛ [3.2], –0
0.059 [1.50]	+0.03 [0.7], –0	+0.03 [0.7], –0	+0.04 [1.0], –0	+1/16 [1.6], –0	+⅛ [3.2], –0
0.098 [2.50]	+0.04 [1.0], –0	+0.04 [1.0], –0	+0.05 [1.2], –0	+1/16 [1.6], –0	+⅛ [3.2], –0
0.138 [3.50]	+0.05 [1.2], –0	+0.05 [1.2], –0	+0.06 [1.5], –0	+1/16 [1.6], –0	+⅛ [3.2], –0
0.3125 [8.00]	+0.08 [2.0], –0	+0.08 [2.0], –0	+0.08 [2.0], –0	+0.16 [4.0], –0	+0.16 [4.0], –0

[A] For specified thicknesses and other than those shown, the tolerances for the next higher thickness shall apply.

TABLE A2.7 Permitted Variations in Length for Cold-Rolled, Wide, Coil-Processed Product as Cut Lengths Not Resquared

Specified Length (L), ft [mm]	Tolerances, in. [mm]	
	Over	Under
Up to 6 [1830], incl	3/16 [4.8]	0
Over 6 [1830]	0.03 × L [0.0025 × L]	0

TABLE A2.8 Permitted Variations in Flatness of Cold-Rolled, Wide, Coil-Processed Product as Cut Lengths

Specified Thickness, in. [mm]	Width, in. [mm]	Length, in. [mm]	Flatness Tolerance,[B] in. [mm]
Not Specified to Stretcher-Leveled Standard of Flatness[A]			
<0.062 [1.57]	≤60 [1524]		0.40 [10]
	>60 [1524]		0.50 [12]
≥0.062 [1.57]	≤60 [1524]		0.40 [10]
	>60 [1524]		0.50 [12]
Stretcher-Leveled Standard of Flatness[C]			
<3/16 [4.76]	<48 [1219]	<96 [2438]	1/8 [3.2]
	<48 [1219]	≥96 [2438]	1/4 [6.4]
<3/16 [4.76]	≥48 [1219]	<96 [2438]	1/4 [6.4]
	≥48 [1219]	≥96 [2438]	1/4 [6.4]

Specified Thickness, in. [mm]	Width, in. [mm]	Flatness Tolerance,[B] in. [mm]	
2xx and 3xx Series Specified to 1/4 and 1/2 Hard Tempers			
		1/4 Hard	1/2 Hard
<0.016 [0.41]	24 [610] to <36 [914]	1/2 [12.70]	3/4 [19.05]
0.016 [0.41] to 0.030 [0.76]		5/8 [15.88]	7/8 [22.22]
>0.030 [0.76]		3/4 [19.05]	7/8 [22.22]
≤0.016 [0.41]	36 [914] to <48 [1219]	5/8 [15.88]	1 [25.40]
>0.016 [0.41] to 0.030 [0.76]		3/4 [19.05]	1 1/8 [28.58]
>0.030 [0.76]		1 [25.40]	1 1/8 [28.58]

[A] Not specified to stretcher-leveled standard of flatness, and not including hard tempers of 2xx and 3xx Series, dead-soft sheets, and deep-drawing sheets.
[B] Maximum deviation from a horizontal flat surface.
[C] Not including hard tempers of 2xx and 3xx Series, dead-soft sheets, and deep-drawing sheets.

TABLE A2.9 Permitted Variations in Thickness of Hot-Rolled, Narrow, Flat-Rolled, Coil-Processed Product as Cut Lengths and Coil

Tolerances for variations of thickness of hot-rolled, narrow, coil-processed product as cut lengths and coil shall be identical to the tolerances for hot-rolled, wide, coil-processed product as listed in Table A2.13, unless otherwise agreed upon by seller and purchaser and specified in the purchase order.

TABLE A2.10 Permitted Variations in Width of Hot-Rolled, Narrow, Flat-Rolled, Coil-Processed Product as Cut Lengths and Coil

Tolerances for variations of width of hot-rolled, narrow, coil-processed product as cut lengths and coil shall be identical to the tolerances for hot-rolled, wide, coil-processed product as listed in Table A2.14 unless otherwise agreed upon by seller and purchaser and specified in the purchase order.

TABLE A2.11 Permitted Variations in Length of Hot-Rolled, Narrow, Coil-Processed Product as Cut Lengths

Tolerances for variations of length of hot-rolled, narrow, coil-processed product as cut lengths shall be identical to the tolerances for hot-rolled, wide, coil-processed product as listed in Table A2.15 unless otherwise agreed upon by seller and purchaser and specified in the purchase order.

TABLE A2.12 Permitted Variations in Flatness of Hot-Rolled, Narrow, Coil-Processed Product as Cut Lengths

Tolerances for variations of flatness of hot-rolled, narrow, coil-processed product as cut lengths shall be identical to the tolerances for hot-rolled, wide, coil-processed product as listed in Table A2.16 unless otherwise agreed upon by seller and purchaser and specified in the purchase order.

TABLE A2.13 Permitted Variations in Thickness of Hot-Rolled, Wide, Coil-Processed Product as Coil and Cut Lengths

Specified Thickness[A], in. [mm]	Permitted Variations, in. [mm], Over and Under, Except as Indicated Otherwise, for Specified Width (w) in. [mm]	
	$w \le 60$ [1525]	$w > 60$ [1525]
0.072 [1.83]	0.006 [0.15]	0.009 [0.22]
>0.072 [1.83] to 0.083 [2.11]	0.007 [0.18]	0.010 [0.25]
>0.083 [2.11] to 0.098 [2.49]	0.008 [0.20]	0.011 [0.27]
>0.098 [2.49] to 0.114 [2.90]	0.009 [0.23]	0.012 [0.30]
>0.114 [2.90] to 0.130 [3.30]	0.011 [0.27]	0.013 [0.33]
>0.130 [3.30] to 0.145 [3.68]	0.012 [0.30]	0.013 [0.33]
>0.145 [3.68] to 0.1875 [4.76]	0.013 [0.33]	0.014 [0.35]
>0.1875 [4.76] to 0.250 [6.35]	–0.010 [0.25], +0.020 [0.50]	–0.010 [0.25], +0.020 [0.50]
>0.250 [6.35] to 0.3125 [7.94]	–0.010 [0.25], +0.022 [0.55]	–0.010 [0.25], +0.022 [0.55]
>0.3125 [7.94]	–0.010 [0.25], +0.030 [0.75]	–0.010 [0.25], +0.030 [0.75]

[A] Thickness measurements are taken at least ⅜ in. [9.52 mm] from the edge of the sheet.

TABLE A2.14 Permitted Variations in Width of Hot-Rolled, Wide, Coil-Processed Product as Cut Lengths (Not Resquared) and Coil

Specified Thickness, t, in. [mm]	Width (w), in. [mm]	Tolerances on Width, in. [mm], for Trimmed Edges
$t <$ 3/16 [4.76]	$w <$ 48 [1219]	+1/16 [1.59], –0
	$w \ge$ 48 [1219]	+¼ [6.35], –0
3/16 [4.76] $\le t <$ ⅜ [9.5]	$w <$ 48 [1219]	+5/32 [3.97], –0
	$w \ge$ 48 [1219]	+⅜ [9.5], –0
$t \ge$ ⅜ [9.5]	$w <$ 48 [1219]	+¼ [6.35], –0
	$w \ge$ 48 [1219]	+7/16 [11.1], –0

TABLE A2.15 Permitted Variations in Length of Hot-Rolled, Wide, Coil-Processed Product as Cut Lengths Not Resquared

Specified Thickness, t, in. [mm]	Length (L), ft [mm]	Tolerances, in. [mm], Over and Under
t < 3/16 [4.76]	$L \le$ 10 [3048]	+¼ [6.35], –0
	10 [3048] < $L \le$ 20 [6096]	+½ [12.7] , –0
t ≥ 3/16 [4.76]	$L \le$ 10 [3048]	+½ [12.7], –0
	10 [3048] < $L \le$ 20 [6096]	+⅝ [15.9], –0

TABLE A2.16 Permitted Variations in Flatness of Hot-Rolled, Wide, Coil-Processed Product as Cut Lengths

Not Specified to Stretcher-Leveled Standard of Flatness		
Specified Thickness (t), in. [mm]	Width (w), in. [mm]	Flatness Tolerance,[A] in. [mm]
$t <$ 3/16 [4.76]	$w \le$ 36 [914],	0.50 [12.7]
	36 [914] < $w \le$ 60 [1524]	0.75 [19.1]
	$w >$ 60 [1524]	1.00 [25.4]
$t \ge$ 3/16 [4.76]	$w \le$ 60 [1524]	0.90 [23]
	60 [1524] < $w \le$ 72 [1829]	1.20 [30]
	$w >$ 72 [1829]	1.50 [38]

Stretcher-Leveled Standard of Flatness			
Specified Thickness (t), in. [mm]	Specified Width (w), in. [mm]	Specified Length (L), in. [mm]	Flatness Tolerance,[A] in. [mm]
$t <$ 3/16 [4.76]	$w \le$ 48 [1219]	$L \le$ 96 [2438]	⅛ [3.18]
	$w \le$ 48 [1219]	$L >$ 96 [2438]	¼ [6.35]
$t <$ 3/16 [4.76]	$w >$ 48 [1219]	$L \le$ 96 [2438]	¼ [6.35]
	$w >$ 48 [1219]	$L >$ 96 [2438]	¼ [6.35]

[A] Maximum deviation from a horizontal flat surface.

TABLE A2.17 Permitted Variations in Thickness of Hot-Rolled Mill Plate (Quarto Plate)[A,B]

Specified Thickness (t), in. [mm]	Width (w), in. [mm]			
	$w \le 84$ [2134]	84 [2134] < $w \le$ 120 [3048]	120 [3048] < $w \le$ 144 [3658]	$w >$ 144 [3658]
	Tolerance Over Specified Thickness,[C] in. [mm]			
$t <$ 3/16 [4.76]	0.055 [1.35]	0.070 [1.78]	. . .	. . .
3/16 [4.76] $\le t <$ 3/8 [9.52]	0.045 [1.14]	0.050 [1.27]	0.085 [2.16]	. . .
3/8 [9.52] $\le t <$ 3/4 [19.05]	0.055 [1.40]	0.060 [1.52]	0.085 [2.16]	0.090 [2.29]
3/4 [19.05] $\le t <$ 1 [25.40]	0.060 [1.52]	0.065 [1.65]	0.085 [2.16]	0.100 [2.54]
1 [25.40] $\le t <$ 2 [50.80]	0.070 [1.78]	0.075 [1.90]	0.095 [2.41]	0.115 [2.92]
2 [50.80] $\le t <$ 3 [76.20]	0.125 [3.20]	0.150 [3.80]	0.175 [4.45]	0.200 [5.08]
3 [76.20] $\le t <$ 4 [101.6]	0.150 [3.81]	0.160 [4.06]	0.200 [5.08]	0.225 [5.72]
4 [101.6] $\le t <$ 6 [152.4]	0.180 [4.57]	0.200 [5.08]	0.335 [8.50]	0.355 [9.02]
6 [152.4] $\le t <$ 8 [203.2]	0.235 [6.00]	0.255 [6.48]	0.355 [9.02]	0.435 [11.0]
8 [203.2] $\le t <$ 10 [254.0]	0.315 [8.00]	0.335 [8.50]	0.435 [11.0]	0.550 [14.0]

[A] Thickness is measured along the longitudinal edges of the plate at least 3/8 in. [9.52 mm], but not more than 3 in. [76.20 mm], from the edge.
[B] For plates up to 10 in. [254.0 mm], excl, in thickness, the tolerance under the specified thickness is 0.010 in. [0.25 mm].
[C] For circles, the over thickness tolerances in this table apply to the diameter of the circle corresponding to the width ranges shown. For plates of irregular shape, the over thickness tolerances apply to the greatest width corresponding to the width ranges shown.

TABLE A2.18 Permitted Variations in Width for Hot-Rolled Rectangular Sheared Plate Mill Plates (Quarto Plates)

Specified Width (w), in. [mm]	Tolerances, over specified width, in. [mm][A]
$w \le 84$ [2135]	5/8 [15.9]
84 [2135] < $w \le$ 108 [2745]	3/4 [19.1]
$w >$ 108 [2745]	1 [25.4]

[A] The tolerance under specified width is 1/4 in. [6.35 mm].

TABLE A2.19 Permitted Variations in Length for Hot-Rolled Sheared Rectangular Plate Mill Plates (Quarto Plates)

Nominal Length (L), in. [mm]	Tolerances, over and under, in. [mm][A]
$L <$ 160 [4064]	3/4 [19.1]
160 [4064] $\le L <$ 240 [6096]	1 1/4 [31.8]
240 [6000] $\le L <$ 315 [8000]	1 5/8 [41.3]
315 [8000] $\le L <$ 394 [10 008]	2 [50.8]
394 [10 008] $\le L <$ 590 [15 000]	2 1/4 [57.2]
590 [15 000] $\le L <$ 790 [20 066]	2 1/4 [57.2]

[A] The tolerance under specified length is 1/4 in. [6.35 mm].

TABLE A2.20 Permitted Variations in Flatness of Plate Mill Plate (Quarto Plate)

NOTE 1—Tolerances in this table apply to any length, not necessarily the rolling direction, up to 36 in. [914 mm] and to any 36 in. [914 mm] of longer lengths in the plane of the plate measured while the plate rests on a flat surface with the concavity of the curvature upward.

NOTE 2—If the longer dimension is under 36 in. [914 mm], the tolerance is not greater than 1/4 in. [6.4 mm].

NOTE 3—For plates with specified minimum yield strengths of 35 ksi [240 MPa] or more, the permitted variations are increased to 1 1/2 times the amounts shown.

Specified Thickness (t), in. [mm]	Flatness Tolerance for Thicknesses Given, in. [mm]
$t <$ 1/4 [6.35]	7/16 [11]
1/4 [6.35] $\le t <$ 3/8 [9.52]	3/8 [9.5]
3/8 [9.52] $\le t <$ 1/2 [12.70]	5/16 [7.9]
1/2 [12.70] $\le t <$ 3/4 [19.05]	5/16 [7.9]
3/4 [19.05] $\le t <$ 1 [25.40]	5/16 [7.9]
1 [25.40] $\le t <$ 1 1/2 [38.10]	1/4 [6.4]
1 1/2 [38.10] $\le t <$ 4 [101.60]	1/4 [6.4]
$t \ge$ 4 [101.60]	1/4 [6.4]

TABLE A2.21 Cold-Rolled Products, Processed Without Coiling

Tolerances for cold-rolled products processed without coiling shall be identical to the tolerances for hot-rolled products processed without coiling as listed in Table A2.17, Table A2.18, Table A2.19, and Table A2.20 unless otherwise agreed upon by seller and purchaser and specified in the purchase order.

TABLE A2.22 Permitted Variations in Width for Cold-Rolled Narrow, Coil-Processed Product in Coils and Cut Lengths for Edge No. 1 or 5

Specified Edge No.	Width, in. [mm]	Thickness, in. [mm]	Width Tolerance for Thickness and Width Given in. [mm]	
			Over	Under
1 and 5	9/32 [7.14] and under	1/16 [1.59] and under	0.005 [0.13]	0.005 [0.13]
1 and 5	over 9/32 [7.14] to 3/4 [19.05], incl	3/32 [2.38] and under	0.005 [0.13]	0.005 [0.13]
1 and 5	over 3/4 [19.05] to 5 [127.00], incl	1/8 [3.18] and under	0.005 [0.13]	0.005 [0.13]
5	over 5 [127.00] to 9 [228.60], incl	0.008 [0.20] to 1/8 [3.18], incl	0.010 [0.25]	0.010 [0.25]
5	over 9 [228.60] to 20 [508.00], incl	0.015 [0.38] to 0.105 [2.67]	0.010 [0.25]	0.010 [0.25]
5	over 20 [508.00] to 24 [610], excl	0.023 [0.58] to 0.080 [2.03]	0.015 [0.38]	0.015 [0.38]

TABLE A2.23 Permitted Variations in Width and Length for Hot-Rolled and Cold-Rolled Resquared Coil-Processed Product (Stretcher Leveled Standard of Flatness)

Specified Dimensions, in. [mm]	Tolerances		
	Over		Under
	in.	mm	
For thicknesses under 0.131 [3.33]:			
Widths up to 48 [1219] excl	1/16	1.59	0
Widths 48 [1219] and over	1/8	3.18	0
Lengths up to 120 [3048] excl	1/16	1.59	0
Lengths 120 [3048] and over	1/8	3.18	0
For thicknesses 0.131 [3.33] up to 3/16 , excl:			
All widths and lengths	1/4	6.35	0

TABLE A2.24 Permitted Variations in Width and Length for Hot-Rolled Product by Abrasive Cutting

Specified Thickness, in. [mm]	Tolerance over Specified Width and Length[A]	
	Width	Length
Up to 1 [25.40], incl	1/8 [3.18]	1/8 [3.18]
1 [25.40] to 2 [50.80], incl	3/16 [4.76]	3/16 [4.76]
2 [50.80] to 3 [76.20], incl	1/4 [6.35]	1/4 [6.35]
3 [76.20] to 4 [101.6], incl[B]	5/16 [7.94]	5/16 [7.94]

[A] The tolerances under specified width and length are 1/8 in. [3.18 mm].
[B] Width and length tolerances for abrasive cut plates over 4 in. [101.6 mm] thick are not included in the table; consult producer.

TABLE A2.25 Permitted Variations in Diameter for Hot-Rolled and Cold-Rolled Coil-Processed Product as Sheared Circles

Specified Thickness, in. [mm]	Tolerance Over Specified Diameter (No Tolerance Under), in. [mm]		
	Diameters Under 30 in. [762]	Diameters 30 [762] to 48 in. [1219]	Diameters Over 48 in. [1219]
Up to 0.0567 [1.45], include	1/16 [1.59]	1/8 [3.18]	3/16 [4.76]
0.0568 [1.45] to 0.0971 [2.46], incl	3/32 [2.38]	5/32 [3.97]	7/32 [5.56]
0.0972 [2.46] up to 3/16 [4.76], excl	1/8 [3.18]	3/16 [4.76]	1/4 [6.35]

TABLE A2.26 Permitted Variations in Diameter for Circular Plates Taken From Hot-Rolled Product Processed With or Without Coiling

Specified Diameter, in. [mm]	Tolerance Over Specified Diameter for Given Diameter and Thickness,[A] in. [mm]		
	To 3/8 [9.52] in., excl, in Thickness	3/8 [9.52] to 5/8 [15.88] in., excl, in Thickness	5/8 [15.88] in. and Over in Thickness[B]
To 60 [1524], excl	1/4 [6.35]	3/8 [9.52]	1/2 [12.70]
60 [1524] to 84 [2134], excl	5/16 [7.94]	7/16 [11.11]	9/16 [14.29]
84 [2134] to 108 [2743], excl	3/8 [9.52]	1/2 [12.70]	5/8 [15.88]
108 [2743] to 180 [4572], excl	7/16 [11.11]	9/16 [14.29]	11/16 [17.46]

[A] No tolerance under.
[B] Circular and sketch plates over 5/8 in. [15.88 mm] in thickness are not commonly sheared but are machined or flame cut.

TABLE A2.27 Torch Cutting Tolerances[A] and Recommended Cleanup Allowance for Rectangular Plates, Circles, Rings, and Sketches

Specified Thickness, in.	Tolerance, in.		Cleanup Allowance[B] per Edge, in.
	Outside Dimension	Inside Dimension	
2 and under	+3/8 , –0	–3/8 , +0	±1/4
Over 2 to 3 incl	+1/2 , –0	–1/2 , +0	±3/8
Over 3 to 6 incl	+3/4 , –0	–3/4 , +0	±1/2

[A] Tolerances to apply unless otherwise agreed. Note that for some applications user may wish to specify minus rather than plus tolerance or vice versa.
[B] Recommended cleanup allowance which, unless otherwise specified, will be applied by supplier to purchasers ordered size.

TABLE A2.28 Permitted Variations in Weight for Hot-Rolled or Cold-Rolled Coil Processed Product with Thickness less than 3/16 in. [4.76 mm]

Any item of five sheets or less, or any item estimated to weigh 200 lb [90.72 kg] or less, may actually weigh as much as 10 % over the theoretical weight	weigh 200 lb [90.72 kg] or less
Any item of more than five sheets and estimated to weigh more than 200 lb [90.72 kg], may actually weigh as much as 7½ % over the theoretical weight	weigh more than 200 lb [90.72 kg]
Chromium-manganese-nickel	40.7 lb/ft^2·in. thickness [7.82 kg/m^2·mm thick]
Chromium-nickel	42.0 lb/ft^2·in. thickness [8.07 kg/m^2·mm thick]
Chromium	41.2 lb/ft^2·in. thickness [7.92 kg/m^2·mm thick]

TABLE A2.29 Permitted Variations in Camber for Cold-Rolled Coil Processed Product in Coils and Cut Lengths[A]

Specified Width, in. [mm]	Tolerance per Unit Length of Any 8 ft [2438 mm], in. [mm]
To 1½ [38.10], incl	½ [12.70]
Over 1½ [38.10] to 24 [609.60], excl	¼ [6.35]

[A] Camber is the deviation of a side edge from a straight line and measurement is taken by placing an 8-ft [2438-mm] straightedge on the concave side and measuring the greatest distance between the strip edge and the straightedge.

TABLE A2.30 Permitted Variations in Camber for Sheared Mill and Universal Mill Plates[A]

Maximum camber	= ⅛ in. in any 5 ft = 3.18 mm in any 1.524 m

[A] Camber is the deviation of a side edge from a straight line, and measurement is taken by placing a 5-ft straightedge on the concave side and measuring the greatest distance between the plate and the straightedge.

A3. PERMITTED VARIATIONS IN DIMENSIONS, ETC.—SI UNITS

A3.1 Listed in Annex A3 are tables showing the permitted variations in dimensions expressed in SI units of measurement. These requirements shall apply to A 480M but shall not apply to A 480. Requirements for A 480 are given in Annex A2.

A3.1.1 The dimensional tolerances are grouped by production method (hot rolling or cold rolling, with or without coiling), product width (narrow (<600 mm) or wide (≥600 mm)), and by product dimension addressed.

A3.2 *Cold-Rolled Narrow (<600 mm width) Coil-Processed Product*—For thickness, width, length, and flatness tolerance tables, refer to Tables A3.1-A3.4.

TABLE A3.1 Permitted Variations in Thickness of Cold-Rolled, Narrow, Coil-Processed Product as Coil and Cut Lengths

NOTE 1—Thickness measurements are taken at least 10 mm in from the edge of the product, except that on widths less than 26 mm, the tolerances are applicable for measurements at all locations.

NOTE 2—The tolerances in this table include crown tolerances.

NOTE 3—For specified thicknesses other than those shown, the tolerances for the next higher thickness shall apply.

Specified Thickness, mm	Thickness Tolerances, for the Thickness and Widths Given, Over and Under, mm		
	Width (w), mm		
	50 to 150, incl $w \le 125$	Over 150 to 300, incl $125 < w \le 250$	Over 300 to 600, excl $250 < w < 600$
	Thickness Tolerances[A]		
0.15	0.010	0.015	0.020
0.25	0.015	0.020	0.025
0.50	0.025	0.030	0.035
0.75	0.030	0.040	0.050
1.00	0.030	0.040	0.050
1.25	0.035	0.045	0.050
1.50	0.040	0.050	0.060
1.75	0.050	0.060	0.070
2.00	0.050	0.060	0.070
2.50	0.050	0.070	0.080
3.00	0.060	0.070	0.090
4.00	0.070	0.070	0.090
4.99	0.070	0.070	0.090

[A] Thickness tolerances given in mm unless otherwise indicated.

A3.3 *Cold-Rolled Wide (≥600 mm width) Coil-Processed Product*—For thickness, width, length, and flatness tolerance tables, refer to Tables A3.5-A3.8.

A3.4 *Hot-Rolled Narrow (<600 mm width) Coil-Processed Product*—For thickness, width, length, and flatness tolerance tables, refer to Tables A3.9-A3.12.

TABLE A3.2 Permitted Variations in Width of Cold-Rolled, Narrow, Coil-Processed Product in Coils and Cut Lengths for Edge No. 3[A]

Specified Thickness[B], mm	Width Tolerance, Over and Under, for Thickness and Width Given, mm			
	$w \le 40$	$40 < w \le 125$	$125 < w \le 250$	$250 < w \le 600$
0.25	0.085	0.10	0.125	0.50
0.50	0.10	0.125	0.15	0.50
1.00	0.125	0.125	0.20	0.50
1.50	0.125	0.15	0.25	0.50
2.50	. . .	0.20	0.30	0.50
3.00	. . .	0.25	0.30	0.60
4.00	. . .	0.25	0.40	0.60
4.99	. . .	0.40	0.50	0.80

[A] For tolerances applicable to narrow product with Edge No. 1 or No. 5, see Table A2.31.

[B] For specified thickness other than those shown, the tolerances for the next higher thickness shall apply.

TABLE A3.3 Permitted Variations in Length of Cold-Rolled, Narrow, Coil-Processed Products as Cut Lengths

Specified Length, mm	Tolerances, mm
≤1500	+3, −0
>1500, ≤4000	+5, −0
>4000, ≤6000	+8, −0

TABLE A3.4 Permitted Variations in Flatness of Cold-Rolled, Narrow, Coil-Processed Product as Cut Lengths

Tolerances for variations of flatness cold-rolled products, narrow, coil-processed product as cut lengths shall be identical to the tolerances for cold-rolled, wide, coil-processed product as listed in Table A3.8, unless otherwise agreed upon by seller and purchaser and specified in the purchase order.

A3.5 *Hot-Rolled Wide (≥600 mm width) Coil-Processed Product*—For thickness, width, length, and flatness tolerance tables, refer to Tables A3.13-A3.16.

A3.6 *Hot-Rolled Product Processed Without Coiling*—For thickness, width, length, and flatness tolerance tables, refer to Tables A3.17-A3.20.

A3.7 *Cold-Rolled Product Processed Without Coiling*—For thickness, width, length, and flatness tolerance tables, refer to Table A3.21.

A3.8 *Tolerances for Other Dimensional Characteristics*—For other tolerance tables, refer to Tables A2.31-A3.29.

TABLE A3.5 Permitted Variations in Thickness of Cold-Rolled, Wide, Coil-Processed Product as Coil and Cut Lengths

NOTE 1—Thickness measurements are taken at least 15 mm from the edge of the product in the case of slit edges and at least 25 mm from the edge of the product in the case of mill edges.

NOTE 2—Cold-rolled sheets in cut lengths and coils are produced in some type numbers and some widths and thickness to tolerances less than those shown in the table.

NOTE 3—For specified thicknesses other than those shown, the tolerances for the next higher thickness shall apply.

Specified Thickness, mm	Permitted Variation, Over and Under, mm, for specified width (w), w in mm		
	$w \le 1000$	$1000 < w \le 1300$	$1300 < w \le 2100$
0.30	0.03	. . .	. . .
0.40	0.04	0.04	. . .
0.50	0.045	0.05	. . .
0.60	0.05	0.05	. . .
0.80	0.05	0.05	. . .
1.00	0.055	0.06	0.07
1.20	0.08	0.08	0.08
1.50	0.08	0.08	0.10
2.00	0.10	0.10	0.11
2.50	0.10	0.11	0.13
3.00	0.13	0.13	0.15
4.00	0.17	0.17	0.17
5.00	0.17	0.17	0.19
6.00	0.17	0.20	0.23
8.00	0.17	0.22	0.25

TABLE A3.6 Permitted Variations in Width of Cold-Rolled, Wide, Coil-Processed Product as Cut Lengths (Not Resquared) and Coil

Specified Thickness, mm[A]	Permitted Variation in Width, mm, for Specified Width (w), mm				
	$w \le 125$	$125 < w \le 250$	$250 < w \le 600$	$600 < w \le 1000$	$1000 < w \le 2100$
1.00	+0.5, –0	+0.5, –0	+0.7, –0	+1.5, –0	+2.0, +0
1.50	+0.7, –0	+0.7, –0	+1.0, –0	+1.5, –0	+2.0, +0
2.50	+1.0, –0	+1.0, –0	+1.2, –0	+2.0, –0	+2.5, –0
3.50	+1.2, –0	+1.2, –0	+1.5, –0	+3.0, –0	+3.0, –0
8.00	+2.0, –0	+2.0, –0	+2.0, –0	+4.0, –0	+4.0, –0

[A] For specified thicknesses other than those shown, the tolerances for the next higher thickness shall apply.

TABLE A3.7 Permitted Variations in Length of Cold-Rolled, Wide, Coil-Processed Product as Cut Lengths Not Resquared

Specified Length (L), mm	Tolerance, mm	
	Over	Under
≤2000	5	0
>2000	$0.0025 \times L$	0

TABLE A3.8 Permitted Variations in Flatness of Cold-Rolled, Wide, Coil-Processed Product as Cut Lengths

Not Specified to Stretcher-Leveled Standard of Flatness[A]		
Specified Thickness, mm	Specified Width, mm	Flatness Tolerance[B], mm
<1.50	<1500	10
	≥1500	12
≥1.50	<1500	10
	≥1500	12

Stretcher-Leveled Standard of Flatness[C]			
Specified Thickness, mm	Specified Width, mm	Specified Length, mm	Flatness Tolerance,[B] mm
≤4.99	<1200	<2400	4
		≥2400	7
	≥1200	<2400	7
		≥2400	7

2xx and 3xx Series Specified to ¼ and ½ Hard Tempers			
Specified Thickness, mm	Specified Width, mm	Flatness Tolerance,[B] mm	
		¼ Hard	½ Hard
≤0.04	600 to 900, excl	19	23
>0.04 to ≤0.80		16	23
>0.80		13	19
≤0.04	900 to 1200, incl	26	29
>0.04 to ≤0.80		19	29
>0.80		16	26

[A] Not specified to stretcher-leveled standard of flatness, and not including hard tempers of 2xx and 3xx series, dead-soft sheets, and deep-drawing sheets.
[B] Maximum deviation from a horizontal flat surface.
[C] Not including hard tempers of 2xx and 3xx series, dead-soft sheets, and deep-drawing sheets.

TABLE A3.9 Permitted Variations in Thickness of Hot-Rolled, Narrow, Flat-Rolled, Coil-Processed Product as Cut Lengths and Coil

Tolerances for variations of thickness of hot-rolled, narrow, coil-processed product as cut lengths and coil shall be identical to the tolerances for hot-rolled, wide, coil-processed product as listed in Table A3.13, unless otherwise agreed upon by seller and purchaser and specified in the purchase order.

TABLE A3.10 Permitted Variations in Width of Hot-Rolled, Narrow, Flat-Rolled, Coil-Processed Product as Cut Lengths and Coil

Tolerances for variations of width of hot-rolled, narrow, coil-processed product as cut lengths and coil shall be identical to the tolerances for hot-rolled, wide, coil-processed product as listed in Table A3.14, unless otherwise agreed upon by seller and purchaser and specified in the purchase order.

TABLE A3.11 Permitted Variations in Length of Hot-Rolled, Narrow, Coil-Processed Product as Cut Lengths

Tolerances for variations of length of hot-rolled, narrow, coil-processed product as cut lengths shall be identical to the tolerances for hot-rolled, wide, coil-processed product as listed in Table A3.15, unless otherwise agreed upon by seller and purchaser and specified in the purchase order.

TABLE A3.12 Permitted Variations in Flatness of Hot-Rolled, Narrow, Flat-Rolled, Coil-Processed Product as Cut Lengths

Tolerances for variations of flatness of hot-rolled, narrow, coil-processed product as cut lengths shall be identical to the tolerances for hot-rolled, wide, coil-processed product as listed in Table A3.16, unless otherwise agreed upon by seller and purchaser and specified in the purchase order.

TABLE A3.13 Permitted Variations in Thickness of Hot-Rolled, Wide, Coil-Processed Product as Coil and Cut Lengths

NOTE 1—Thickness measurements are taken at least 10 mm from the edge of the product.

NOTE 2—For specified thicknesses other than those shown, the tolerances for the next higher thickness shall apply.

	Permitted Variations of Thickness, mm, Over and Under, Except as Indicated Otherwise, for Specified Width (w)	
Specified Thickness, mm	$w \leq 1500$	$w > 1500$
2.0	0.18	0.25
2.25	0.20	0.27
2.5	0.23	0.30
3.0	0.25	0.33
3.5	0.30	0.33
5.0	–0.25, +0.47	–0.25, +0.51
6.0	–0.25, +0.51	–0.25, +0.51
8.0	–0.25, +0.75	–0.25, +0.75

TABLE A3.14 Permitted Variations in Width of Hot-Rolled, Wide, Coil-Processed Product as Cut Lengths (Not Resquared) and Coil

Specified Dimension, mm		Tolerance on Width, mm, for Trimmed Edges	
Thickness (t), mm	Width (w), mm	Over	Under
<5.00	$w < 1200$	2	0
	$w \geq 1200$	6	0
$5.00 < t \leq 10.00$	$w < 1200$	4	0
	$w \geq 1200$	9	0
>10.00	$w < 1200$	6	0
	$w \geq 1200$	12	0

TABLE A3.15 Permitted Variations in Length of Hot-Rolled, Wide, Coil-Processed Product as Cut Lengths Not Resquared

Specified Length (L), mm	Tolerance, mm	
	Over	Under
$L < 3000$	12	0
$3000 \leq L \leq 6000$	$(0.005 \times L)$	0

TABLE A3.16 Permitted Variations in Flatness of Hot-Rolled, Wide, Coil-Processed Product as Cut Lengths

Not Specified to Stretcher-Leveled Standard of Flatness		
Specified Thickness (t), mm	Specified Width (w), mm	Flatness Tolerance,[A] mm
$t < 5$	$w < 900$	13
	$900 \leq w < 1500$	19
	$w \geq 1500$	26
$t \geq 5$	$w < 1500$	23
	$1500 \leq w < 1800$	30
	$w \geq 1800$	38

Stretcher-Leveled Standard of Flatness			
Specified Thickness (t), mm	Specified Width (w), mm	Specified Length (L), mm	Flatness Tolerance,[A] mm
$t \leq 13$	$w < 1200$	$L < 2400$	4
		$L \geq 2400$	7
	$w \geq 1200$	$L < 2400$	7
		$L \geq 2400$	7

[A] Maximum deviation from a horizontal flat surface.

TABLE A3.17 Permitted Variations in Thickness of Hot-Rolled Plate Mill Plate (Quarto Plate)[A,B]

NOTE 1—For specified thicknesses other than those shown, the tolerances for the next higher thickness shall apply.

Specified Thickness, mm	Width (w), mm			
	$w < 2100$	$2100 \leq w < 3000$	$3000 \leq w < 3600$	$w \geq 3600$
	Tolerance Over Specified Thickness, mm			
5	1.35	1.75	. . .	. . .
8	1.15	1.30	2.15	. . .
10	1.15	1.30	2.15	. . .
20	1.40	1.55	2.15	2.30
25	1.55	1.65	2.15	2.55
50	1.80	1.90	2.40	2.95
75	3.20	3.80	4.45	5.10
100	3.75	4.00	5.00	5.70
150	4.50	5.00	8.50	9.00
200	6.00	6.50	9.00	11.0
250	8.00	8.50	11.0	14.0

[A] Thickness is measured along the longitudinal edges of the plate at least 10 mm but not more than 75 mm from the edge.

[B] For circles, the over thickness tolerances in this table apply to the diameter of the circle corresponding to the width ranges shown. For plates of irregular shape, the over thickness tolerances apply to the greatest width corresponding to the width ranges shown. For plates up to 250 mm, incl, in thickness, the tolerance under the specified thickness is 0.30 mm.

TABLE A3.18 Permitted Variations in Width for Hot-Rolled Rectangular Sheared Plate Mill Plates (Quarto Plates)

Specified Width (w), mm	Tolerances, over and under, mm
$w < 2000$	+15, –0
$2000 \leq w < 3000$	+20, –0
$w \geq 3000$	+25, –0

TABLE A3.19 Permitted Variations in Length for Hot-Rolled Sheared Rectangular Plate Mill Plates (Quarto Plates)

Nominal Length (L), mm	Tolerances, Over and Under, mm
$L < 4000$	+20, –0
$4000 \leq L < 6000$	+30, –0
$6000 \leq L < 8000$	+40, –0
$8000 \leq L < 10\,000$	+50, –0
$10\,000 \leq L < 15\,000$	+75, –0
$15\,000 \leq L < 20\,000$	+100, –0

TABLE A3.20 Permitted Variations in Flatness of Plate Mill Plate (Quarto Plate)

NOTE 1—Tolerances in this table apply to any length, not necessarily the rolling direction, up to 36 in. [914 mm] and to any 36 in. [914 mm] of longer lengths in the plane of the plate measured while the plate rests on a flat surface with the concavity of the curvature upward.

NOTE 2—If the longer dimension is under 36 in. [914 mm], the tolerance is not greater than ¼ in. [6.4 mm].

NOTE 3—For plates with specified minimum yield strengths of 35 ksi [240 MPa] or more, the permitted variations are increased to 1½ times the amounts shown.

NOTE 4—For specified thicknesses other than those shown, the tolerances for the next higher thickness shall apply.

Specified Thickness (*t*), in. [mm]	Flatness Tolerance for Thicknesses Given, in. [mm]
5	0.40 [10]
10	⅜ [9.5]
15	5/16 [7.9]
20	5/16 [7.9]
25	5/16 [7.9]
50	¼ [6.4]
150	¼ [6.4]
>150	¼ [6.4]

TABLE A3.21 Cold-Rolled Products, Processed Without Coiling

Tolerances for cold-rolled products processed without coiling shall be identical to the tolerances for hot-rolled products processed without coiling as listed in Table A3.17, unless otherwise agreed upon by seller and purchaser and specified in the purchase order.

TABLE A3.22 Permitted Variations in Width and Length for Hot-Rolled and Cold-Rolled Resquared Coil-Processed Product (Stretcher Leveled Standard of Flatness)

NOTE 1—Polished sheets with Finishes No. 4 and higher are produced to tolerances given in this table.

Specified Dimensions, mm			Width and Length Tolerance, mm	
Thickness	Width	Length	Over	Under
Under 3.30	Up to 1200	Up to 3000	2	0
	1200 and over	3000 and over	3	0
3.30 and over	All	All	7	0

TABLE A3.23 Permitted Variations in Abrasive Cutting Width and Length for Plates

Specified Thickness, [mm]	Tolerance over Specified Width and Length,[A] mm	
	Width	Length
Up to 25, incl	3.2	3.2
25 to 50, incl	4.8	4.8
50 to 75, incl	6.4	6.4
75 to 100, incl[B]	7.9	7.9

[A] The tolerances under specified width and length are 3.2 mm.
[B] Width and length tolerances for abrasive cut plates over 100 mm thick are not included in the table; consult producer.

TABLE A3.24 Permitted Variations in Diameter for Hot-Rolled and Cold-Rolled Coil-Processed Product as Sheared Circles

Specified Thickness, mm	Tolerance Over Specified Diameter (No Tolerance Under), mm		
	Diameters Under 600	Diameters 600 to 1200 incl	Diameters Over 1200
Under 1.50	2	3	5
1.50 to 2.50 excl	3	4	6
2.50 and thicker	4	5	7

TABLE A3.25 Permitted Variations in Diameter for Circular Plates Taken From Hot-Rolled Product Processed With or Without Coiling

NOTE 1—For specific diameters other than those shown, the tolerance for the next higher diameter shall apply.

Specified Diameter, mm	Tolerance Over Specified Diameter for Given Diameter and Thickness,[A] mm		
	Thickness of Plate		
	To 10, excl	10 to 15, excl	15 and over
1500 and under	7	10	13
2100	8	13	16
2700	10	11	15
4500	11	15	18

[A] No tolerance under.

TABLE A3.26 Torch Cutting Tolerances[A] and Recommended Cleanup Allowance for Rectangular Plates, Circles, Rings, and Sketches

Specified Thickness, mm	Tolerance, mm		Cleanup Allowance[B]
	Outside Diameter	Inside Diameter	Per Edge, mm
51 and under	+10, –0	–10, +0	±6
Over 51 to 76 incl	+13, –0	–13, +0	±10
Over 76 to 152 incl	+19, –0	–19, +0	±13

[A] Tolerances to apply unless otherwise agreed. Note that for some applications user may wish to specify minus rather than plus tolerance or vice versa.
[B] Recommended cleanup allowance which, unless otherwise specified, will be applied by supplier to purchasers ordered size.

TABLE A3.27 Permitted Variations in Weight for Hot-Rolled and Cold-Rolled Sheets

Any item of five sheets or less, and estimated to weigh 100 kg or less, may actually weigh 10 % over the theoretical weight	weigh 100 kg or less
Any item of more than five sheets and estimated to weigh more than 100 kg, may actually weigh 7 ½ % over the theoretical weight	weigh more than 100 kg
Chromium-manganese-nickel	7.82 kg/m^2/mm thick
Chromium-nickel	8.07 kg/m^2/mm thick
Chromium	7.92 kg/m^2/mm thick

TABLE A3.28 Permitted Variations in Camber for Cold-Rolled Narrow Coil-Processed Product in Coils and Cut Lengths[A]

Specified Width, mm	Tolerance Per Unit Length Of Any 2400 mm
To 40, incl	13
Over 40 to 600, incl	7

[A] Camber is the deviation of a side edge from a straight line and measurement is taken by placing a 2400-mm straightedge on the concave side and measuring the greatest distance between the strip edge and the straightedge.

TABLE A3.29 Permitted Variations in Camber for Hot-Rolled and Cold-Rolled Wide Coil-Processed Product as Cut Lengths Not Resquared and Cold-Rolled Wide Coil-Processed Product as Coils[A]

Specified Width, mm	Tolerance per Unit Length of Any 2400 mm, mm
600 to 900, excl	4
900 and over	3

[A] Camber is the greatest deviation of a side edge from a straight line and measurement is taken by placing an 8-ft [2438-mm] straightedge on the concave side and measuring the greatest distance between the sheet edge and the straightedge.

A4. REQUIREMENTS FOR THE INTRODUCTION OF NEW MATERIALS

A4.1 New materials may be proposed for inclusion in specifications referencing this specification subject to the following conditions:

A4.1.1 Application for the addition of a new grade to a specification shall be made to the Chairman of the subcommittee which has jurisdiction over that specification.

A4.1.2 The application shall be accompanied by a statement from at least one user indicating that there is a need for the new grade to be included in the applicable specification.

A4.1.3 The application shall be accompanied by test data as required by the applicable specification. Test data from a minimum of three test lots, as defined by the specification, each from a different heat, shall be furnished.

A4.1.4 The application shall provide recommendations for all requirements appearing in the applicable specification.

A4.1.5 The application shall state whether the new grade is covered by patent.

SUMMARY OF CHANGES

Committee A01 has identified the location of selected changes to this standard since the last issue, A 480/A 480M – 04a, that may impact the use of this standard. (Approved Sept. 15, 2005.)

(*1*) Revised Section 6 to address chemical requirements as applicable to different categories of elements.

Committee A01 has identified the location of selected changes to this standard since the last issue, A 480/A 480M – 04, that may impact the use of this standard. (Approved Sept. 1, 2004.)

(*1*) Revised the thickness tolerances for the plate thicknesses in Table A2.13 and Table A3.13.
(*2*) Revised width and length tolerances for hot-rolled, wide, coil-processed product in Table A2.14, Table A2.15, Table A3.14, and Table A3.15.
(*3*) Added Keywords.